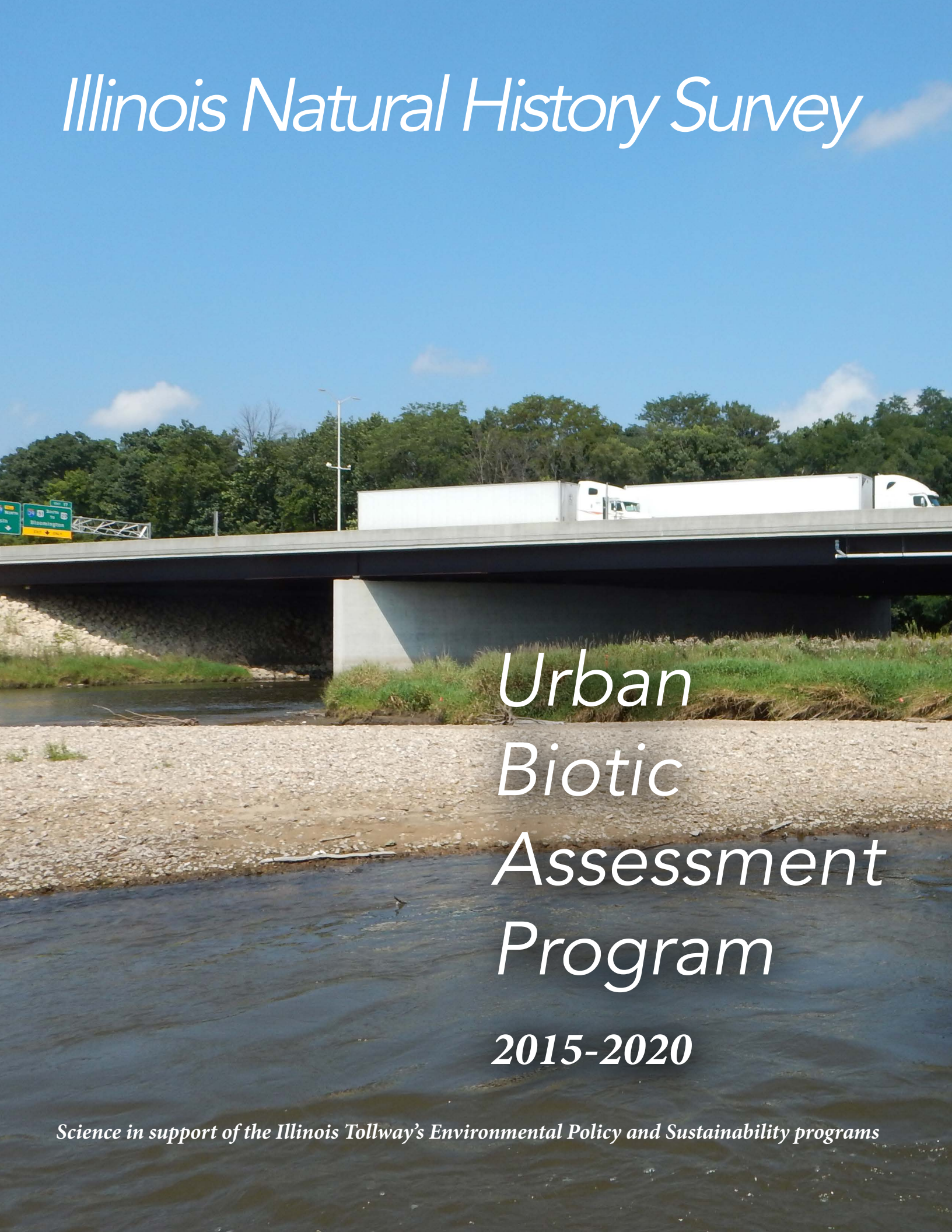
Illinois Natural History Survey



Urban Biotic Assessment Program

2015-2020

Science in support of the Illinois Tollway's Environmental Policy and Sustainability programs

Illinois Natural History Survey

Urban Biotic Assessment Program
2015-2020 Report

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Illinois Tollway

Endangered and Threatened Species along the Tollway Corridor

The Illinois State Toll Highway Authority maintains 294 miles of roadway situated in the heavily urbanized northeastern Illinois region. Within the vicinity of the network, there are a diversity of organisms and habitats. There are 2,442 element occurrence records (EOR) of 113 species within 1-mile of a toll road and numerous natural areas, forest preserves, and state parks, including 9 high-quality wetlands and 112 high-quality terrestrial communities, and numerous Species of Greatest Conservation Need (SGCN). Federally endangered and threatened species in the corridor include: Eastern Massasauga Rattlesnake (EMR), Rusty Patched Bumble Bee (RPBB), Hine's Emerald Dragonfly (HED), Black Rail, Indiana Bat, Northern Long-eared Bat (NLEB), and Eastern Prairie Fringed Orchid (EPFO).

In 2011, the Illinois Tollway undertook a 15-year, $14 billion capital program, "Move Illinois: The Illinois Tollway Driving the Future." The Illinois Natural History Survey's Urban Biotic Assessment Program (UBAP) was contracted to provide environmental expertise, survey endangered and threatened species, and monitor mitigation sites. This report provides an overview of our findings across the Tollway network from 2015–2020.

Since 2015, UBAP has surveyed areas potentially impacted by construction along the Spur, the Elgin O'Hare West Access (IL-390), the Jane Addams Memorial Tollway (I-90), the Tri-State Tollway (I-294) including the Mile-Long Bridge and the I-57 junction, the new I-490 tollway around O'Hare Airport and the Tri-county Access Project. We have surveyed nearly 100 stream crossings and detected over 169 species of birds and 29 species of native mussels.

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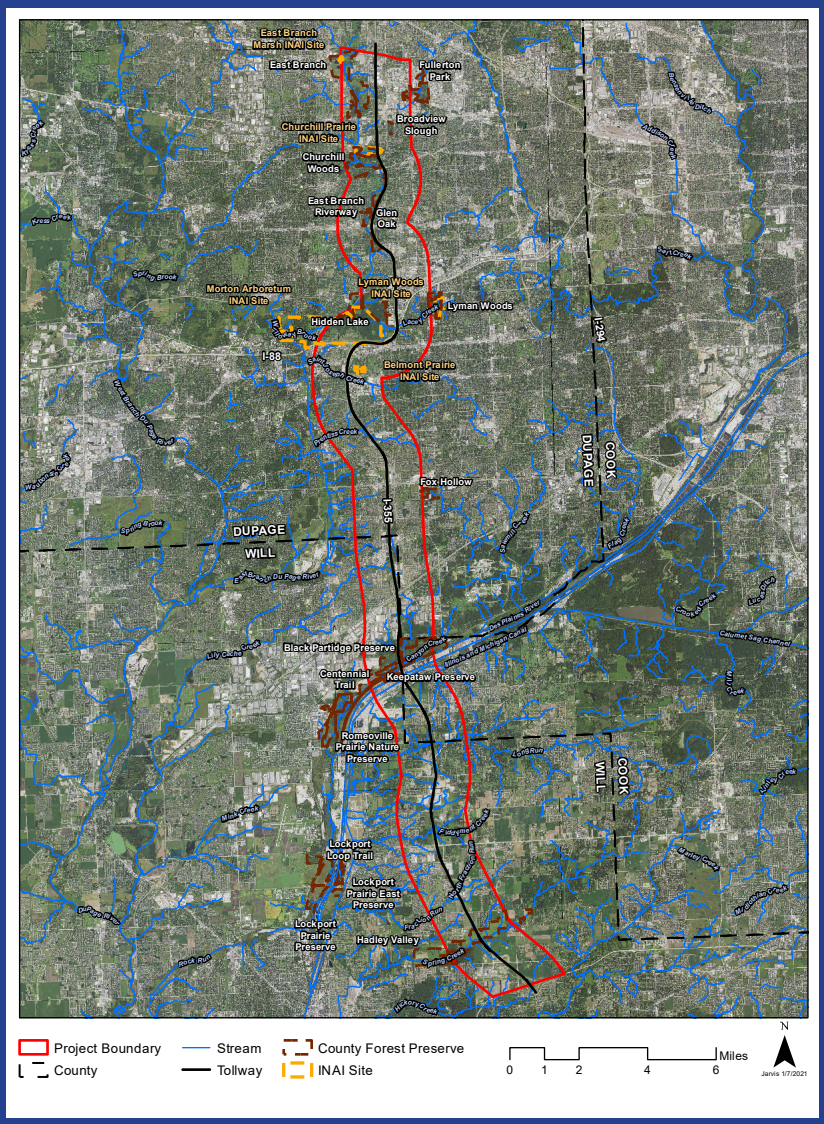
Veterans Memorial



Veterans Memorial Tollway at a Glance:

- *32 mile segment of road with 270,000 vehicles/day*
- *29 listed species*
- *5 federally protected:*
  - *Rusty Patched Bumble Bee*
  - *Hine's Emerald Dragonfly*
  - *Northern Long-eared Bat*
  - *Eastern Prairie Fringed Orchid*
  - *Leafy Prairie Clover*
- *Long-term monitoring of Blanding's Turtle*

Originally named the North-South Tollway, I-355 opened in 1989 as an 18-mile stretch connecting I-55 to I-290 to ease congestion in the growing western suburbs. As the population in the southwest suburbs grew, I-355 was extended 12 miles to connect to I-80. INHS researchers were contracted in 2005 to monitor 2 protected turtle species in the corridor, the Spotted Turtle and the Blanding's Turtle, thus beginning our relationship with the Illinois Tollway. The 30-mile-long Veterans Memorial Tollway was dedicated in 2007 and now serves over 270,000 vehicles per day.

Hine's Emerald Dragonfly

Interstate 355

South Corridor

We continue to monitor the region for potential impacts, reassessing the EORs, potential changes to resources, and assess the mitigation measures, including restoration projects. Of particular importance is the 1.3-mile-long bridge spanning the Des Plaines River and several nature preserves, Keepataw Forest Preserve (Keepataw) in Will County and Black Partridge Woods Forest Preserve (Black Partridge) in Cook County.

In 2017, we conducted surveys of Spring Creek and Long Run for state-endangered, threatened, and SGCN fauna (mussels, fish, birds, macroinvertebrates, reptiles, and bats) to estimate species richness and diversity across taxa. We compared our findings to pre-construction surveys and then provided management recommendations for bolstering species richness, diversity, and persistence. Besides constructing the I-355 south extension, the once channelized Spring Creek has undergone major habitat modifications, restoration meanders, and reduction in flow velocity. (INHS 2018:6).

Mollusks

The pollution tolerant Giant Floater was the most commonly collected mussel species, but we also captured the state-threatened Slippershell Mussel at Spring Creek and Long Run, which had not been found alive in surveys in the past several decades. We found live Lilliputs, Cylindrical Papershells, and Creek Heelsplitters.

Overall we found 5 live species and relict shells of 3 other species. Previous surveys found only dead or relict shells in Long Run and at Spring Creek. We found a few live mussels of 2 species: Cylindrical Papershell and Ellipse, which were not found in our surveys. Water quality improvements and habitat restoration have likely contributed to the increase in mussel species richness. We also encountered live Chinese Mystery Snails and an abundance of the invasive Asian Clam species in Long Run. These had not been observed in previous surveys, and it remains to be seen how the increase in invasive clams and snails will impact mussels in the future.

Slippershell Mussel

Aquatic Macroinvertebrates

We identified 24 macroinvertebrate taxa at Long Run and 22 at Spring Creek, yielding a "good" rating for both streams. The amphipod *Hyalella sp.* and chironomid midges were abundant at both sites; both groups are indicators of good water quality. Samples collected in the 1980s, before any construction, contained more taxa, but protocols differed and focused on worms and leeches. The decreased streamflow from the de-channelization of Spring Creek can adversely impact macroinvertebrates.

We have conducted visual encounter surveys for the federally endangered Hine's Emerald Dragonfly (HED) at Lockport Prairie and Keepetaw Preserve. We have verified their continued existence at Lockport Prairie, albeit with small numbers, and observed 11 other dragonfly species. At Keepetaw Preserve, we observed 10 species of dragonflies over 3 days in late June, but no adult HEDs. While this should have been within the flight season for HED, it is possible spring flooding affected adult emergence at the site. However, we had observed adult HEDs at Lockport the week prior. This work is helping us develop a species distribution model and determine species detectability.

Veterans Memorial

Fish

We encountered 8 fish species at Long Run and 9 at Spring Creek. Compared to samples collected in 1988, there were no noticeable differences in pre- and post-construction fish communities at Long Run, but there was a significant decrease at Spring Creek. The significant decreases to the fish community in Spring Creek were likely unrelated to Tollway construction activities. Unrelated modifications to Spring Creek have resulted in a more intermittent stream, decreasing connectivity needed by many fish species. Interestingly, the accumulation of gravel and sand in the erosion control structure below the new Tollway bridge has created suitable riffle habitat for multiple darter species.

Reptiles and Amphibians

Over the past 5 years, we have trapped for Blanding's Turtles and Spotted Turtles at Keepetaw, Centennial Marsh, Black Partridge, Romeoville Prairie, and Lockport Prairie. In 2009, 199 head-started Blanding's Turtles were released into Keepetaw. We recaptured 1 of those individuals in 2016. We also captured 7 new young Blanding's Turtles at Centennial Marsh (3 in 2015 and 4 in 2017), indicating successful recruitment is occurring (INHS 2016:1; INHS 2017:15; INHS 2017:13; ME16-1; ME18-16).

Blanding's Turtle

Erosion control structure

We encountered 6 frog species and 4 snake species during our surveys, with Common Gartersnakes and Bullfrogs being the most abundant. All of the frog and snake species encountered are common species found in disturbed habitats.

The turtle populations in the region have been declining, with suitable habitat located in a highly fragmented, heavily urbanized landscape. Most juvenile Blanding's Turtles have been found on the south side of the Des Plaines River and Asian Carp Barrier. Connectivity to other populations is limited to the passage gates in the concrete barrier. Turtle conservation efforts should focus on habitat connectivity and adult survival to encourage survival of these populations (INHS 2020:3).

Interstate 355

Tree Sparrow

Birds

We detected 74 bird species, 69 at Black Partridge and 39 at Hadley Valley, none of which were endangered or threatened. However, we detected 8 SGCN, including the Chimney Swift, Field Sparrow, Northern Flicker, and Rusty Blackbird.

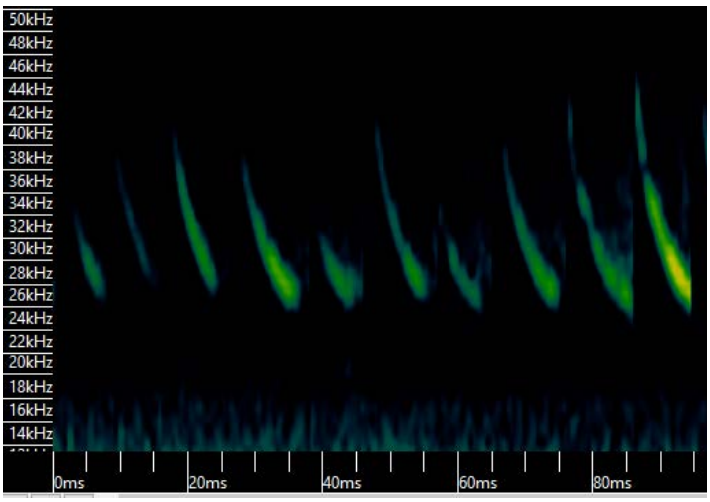
Avifaunal diversity at Black Partridge Preserve is consistently higher than at other Cook County preserves we have monitored. Black Partridge is bordered by the Des Plaines River and adjacent to the large Waterfall Glen Forest Preserve. Both preserves serve as important stopover habitat for migratory birds and likely increase bird diversity at Black Partridge. Planting native deciduous shrubs may open the forest canopy and increase insect and fruit abundances, further enhancing the attractiveness to migratory birds.

While we detected fewer species at Hadley Valley, this may be due to reduced sampling effort compared to Black Partridge. Hadley is a mix of grasslands and wetlands, and management of shrubs via mowing and prescribed burns would be beneficial to the species using the site (INHS 2018:6).

Bats

We deployed acoustic monitors for 24 nights during spring, summer, and fall near the I-355 Des Plaines River crossing and 18 nights at Keepetaw Forest Preserve. We identified Big Brown, Eastern Red, Hoary, Silver-haired, and Tri-colored bats and the federally threatened Northern Long-eared Bat (NLEB) along the Des Plaines River. Summer had the highest level of bat activity and is when we would anticipate a higher likelihood of encountering Little Brown Bats and NLEBs. The detection of *Myotis* species was low, but increasing roosting habitat and connectivity between forest patches could increase bat occupancy.

Though we detected differences in species composition for some taxa, the I-355 south extension construction did not appear to have caused any significant loss of species diversity. The Tollway implemented measures to prevent direct runoff from the highway, which protected the aquatic habitats. Overall, with continued protection and maintenance, natural areas in the I-355 south corridor can provide habitat for numerous species and promote conservation awareness for residents (INHS 2018:6).



Big Brown Bat sonogram

Veterans Memorial

Richardson Rush

Central and Northern Corridor

The Central Veterans Memorial Tollway stretches from I-55 to I-88 and the Northern Veterans Memorial Tollway extends north from I-88 to its junction with I-290. In 2018 and 2019, the Tollway undertook improvements along the central and northern portions of I-355, smoothing pavement and widening the roadway between Butterfield Road (IL-56) and Roosevelt Road (IL-38). Improvements to roadway lighting, signage and guardrails, and retaining and noise wall work were also completed. This stretch of roadway is traveled by over 100,000 vehicles per day. Although the work was conducted within the ROW, we targeted assessments for species with recent EORs in the area: Iowa Darter, Blanding's Turtle, Yellow-headed Blackbird, Least Bittern, NLEB, and Tube Beard Tongue. We also conducted general aquatic and terrestrial surveys along the northern I-355 corridor at Morton Arboretum, East Branch Forest Preserve, Hidden Lake Forest Preserve, Churchill Woods and Prairie, and Lyman Woods.

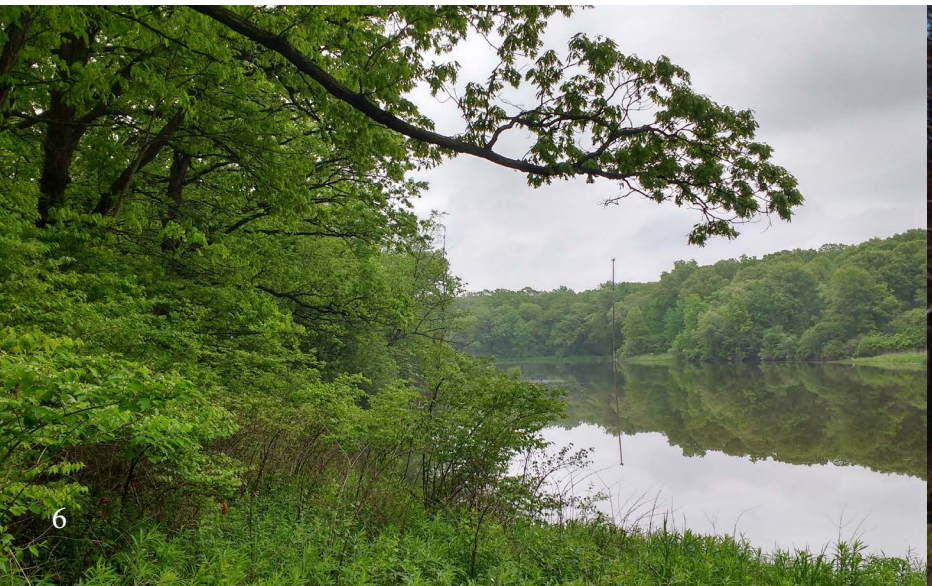
Aquatic Macroinvertebrates

We surveyed 3 streams that would potentially be impacted by construction: St. Joseph Creek, Prentiss Creek, and Lily Cache Creek for aquatic macroinvertebrates, mussels, and fish. We sampled an unnamed tributary of the East Branch of the DuPage River for aquatic invertebrates and fish. Surveys yielded Annelids (worms and leeches), chironomid midges, and the snail *Physella sp.*, while sensitive groups of EPTs were absent. Dragonflies (*Sympetrum sp.* and *Anax sp.*) and damselfly nymphs (Coenagrionidae) were relatively abundant at the unnamed tributary. Based on aquatic invertebrates, Prentiss and St. Joseph creeks rated "poor" while Lily Cache Creek and the tributary rated "fair."

Mollusks

Mollusk communities were depauperate, with only 1 native mussel, 4 native snails, and an abundance of the invasive Asian Clam. We captured no fish at Prentiss Creek or the tributary and only captured fish species considered "tolerant" or "moderately tolerant" of poor water quality from St. Joseph and Lily Cache Creeks. There are records of Iowa Darters downstream of I-355, but multiple retention ponds likely limit upstream migration (INHS 2019:1; ME18-2).

Yellow Warbler



Interstate 355

Reptiles and Amphibians

We encountered common turtle, frog, salamander, and snake species at wetlands and lakes in East Branch, Hidden Lake, and Morton Arboretum. We captured 173 turtles, but no Blanding's Turtles. Preserving fish-free ponds and wetlands and maintaining terrestrial habitat connectivity will support the amphibian populations present (ME18-1).

Birds

While there are no Yellow-headed Blackbird reports in the corridor, there is potentially suitable habitat (ME18-5). We detected 88 bird species at East Branch Forest Preserve, 74 species at Hidden Lake and Belmont Prairie, and 89 species at the Morton Arboretum, but no Yellow-headed Blackbirds. We detected the state-threatened Least Bittern at East Branch Marsh. Goldfinches and American Robins were common at all sites, but the Morton Arboretum showed an exceptionally high warbler density and diversity (22 species). Overall, we detected 13 SGCN birds, including Marsh Wren, Bell's Vireo, Brown Thrasher, Eastern Towhee, Field Sparrow, and Willow Flycatcher. The Bell's Vireo merits specific mention, as it is a species declining throughout its range and in 2018 it was only reported from 6 sites in DuPage County. Many of these SGCNs are wetland or shrubland species, so improving shrubland habitat and increasing emergent vegetation cover in wetlands would be beneficial (INHS 2019:5).

Bats

Using acoustic monitors at Churchill Prairie and Morton Arboretum, we identified 7 bat species with a high degree of confidence: the Big Brown, Eastern Red, Hoary, Silver-haired, Little Brown, NLEB, and Evening Bats. We recorded the highest bat activity levels during the summer at Morton Arboretum, dominated by Big Brown Bats. The federally threatened NLEB was detected in spring and summer at Morton Arboretum within the I-355 corridor. Avoiding construction activities during the most active summer season would benefit the bat populations in the corridor, including the federally threatened NLEB (ME18-3).

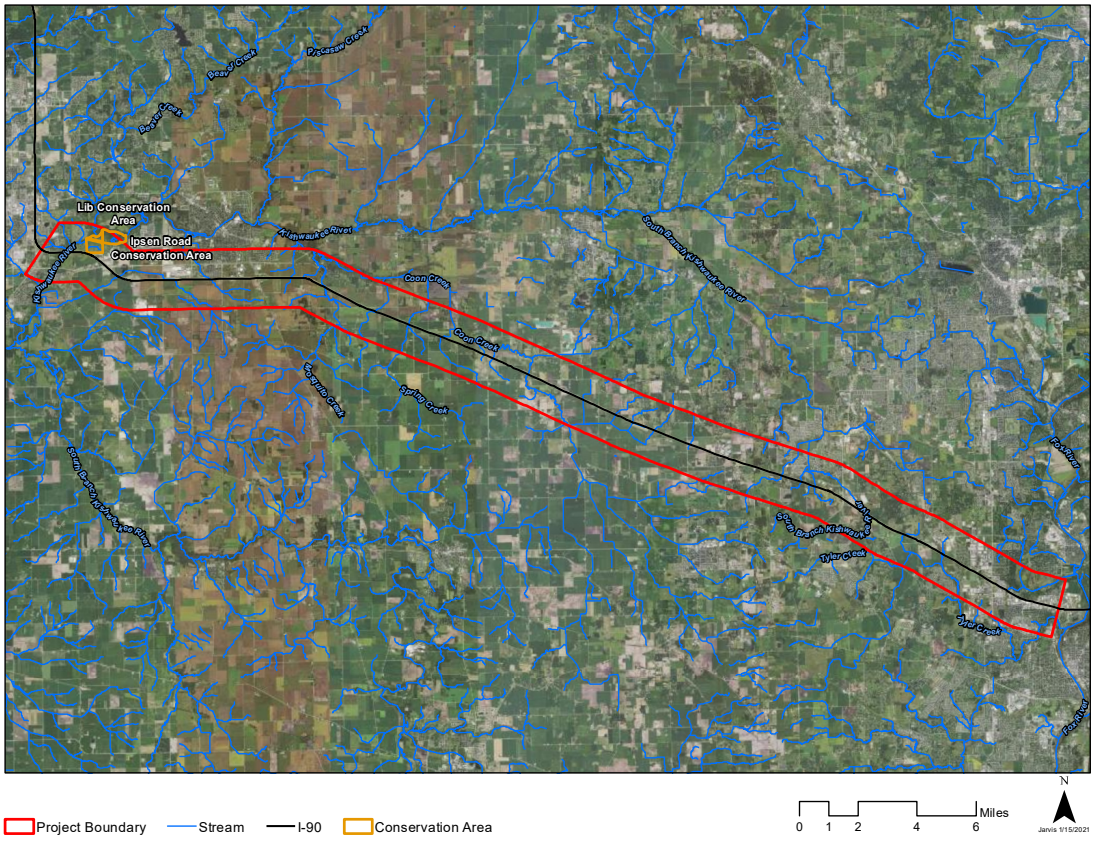
Tube Beard Tongue

Plants

We detected 3 state-threatened and 3 state-endangered plant species in the East Branch Forest Preserve habitat complex and Churchill Prairie and Woods, including the federally threatened Eastern Prairie Fringed Orchid (EPFO). Although we did not find it, we determined that the state-endangered Mosquito Rush likely persists at Lyman Woods but entirely outside of the Tollway impact zone. We also did not locate 3 state-listed plants previously recorded at Morton Arboretum. Rare plants at East Branch Marsh would benefit from invasive Reed Canary Grass removal and native shrub restoration by planting strips of shrubs in the upland habitat (ME18-4).

Our findings indicated construction activities would not impact aquatic species, and the streams being impacted were "fair" at best. The lack of diversity is likely attributable to the impacts of heavy urbanization throughout the region. Maintaining and improving existing habitat could be achieved by restoring the natural flow regime and connectivity of waterways and managing stream inputs to improve water quality. The plant species of concern were on protected lands, and therefore work constrained to the Tollway right of way should not impact them.

Jane Addams Memorial



Jane Addams at a Glance:

- *77 mile segment of road with 335,000 vehicles/day*
- *54 listed species,*
- *2 federally protected:*
  - *Rusty Patched Bumble Bee*
  - *Prairie Bush Clover*
- *We detected 8 bat species*
  - *NLEB and Indiana Bat*
- *Kishwaukee River*
  - *Long term monitoring of high quality mussel community*
  - *Assessed translocation success of mussels*
  - *Monitoring mussel movement and survival*
  - *Fulfilled Black Sandshell incidental take*

The Jane Addams Memorial Tollway (I-90) is a 77-mile segment of the United States' longest interstate. Constructed in the 1950s, this stretch of aging roadway is traveled by over 350,000 vehicles per day. Planning for the Jane Addams Memorial Tollway Rebuilding and Widening Project began in 2011 to ease congestion and increase mobility in the corridor. The project is a significant undertaking by the Illinois Tollway, which included expanding from 2 to 3 lanes, and replacing the bridge over the Kishwaukee River near Rockford in 2014 and the bridge over the Fox River in Elgin in 2017. This stretch of roadway also includes numerous smaller stream crossings that could be potentially impacted by construction. Because the project would potentially impact aquatic organisms, we began surveying mussel communities in streams along I-90 in 2006 and added amphibians, reptiles, and fish in 2012. We returned in 2015 and 2017 to survey post-construction, adding birds and aquatic macroinvertebrates (INHS 2018:5).

Mollusks

The Kishwaukee River contains one of the most diverse mussel assemblages remaining in Illinois, including populations of species in greatest conservation need. The Tollway applied for an incidental take permit for the state-threatened Black Sandshell population. As part of the incidental take authorization, we captured 8 gravid female Black Sandshells and sent them to Genoa National

Interstate 90

Black Sandshell

Fish Hatchery for propagation. In May 2015, 425 Walleye were inoculated with glochidia (larval mussels) and released into the Kishwaukee River.

Before bridge replacement, we relocated 100 mussels approximately 200 m upstream and monitored their survival. We concluded short-distance translocation before a bridge replacement is a viable tool for species conservation but does not eliminate all mortality (See Research section below). Following the 2014 bridge replacement and in-stream modifications, we resurveyed and encountered 515 live mussels of 15 species in the Kishwaukee River. The most common species were Mucket and Plain Pocketbook, but we also found 23 individual state-threatened Black Sandshells (INHS 2016:13).

We found 74 mussels in Mosquito Creek during this time, with White Heelsplitters being the most abundant, but we also encountered 2 state-threatened Slippershell Mussels. We found 46 mussels, including 20 individuals of the Slippershell Mussel, in Spring Creek. At Site 11, an unnamed tributary, we found only 1 mussel, a Cylindrical Papershell. Our findings in 2015 were not significantly different from pre-construction surveys, suggesting no short-term impacts to the freshwater mussel community.

We returned in 2017 following the completion of construction along I-90 and encountered 449 live individuals of 15 mussel species in the Kishwaukee River and 419 individuals of 13 species across the other 10 locations within the corridor. As in 2015, the most common species in the Kishwaukee River were Mucket and Plain Pocketbook, but we also found 35 individuals of the state-threatened Black Sandshell and 3 Ellipses, an SGCN. In the tributaries, White Heelsplitters and Threeridges were the most abundant species, but we also found the state-threatened Slippershell Mussel in Mosquito, Coon, and Spring creeks. Mussel communities along the I-90 Tollway corridor appear to have remained intact post-construction (INHS 2018:05).

We continue to monitor the survival and movement of the mussel population in the Kishwaukee River, and our work is helping to inform mitigation efforts implemented before and during future construction projects. Short-distance upstream relocations can mitigate some impacts to mussel populations from bridge replacements before instream work (INHS 2017:11; INHS 2018:19; INHS 2019:19).

Ellipse

Jane Addams Memorial

Aquatic Macroinvertebrates

We collected samples of aquatic macroinvertebrates to determine the stream quality following construction along I-90. In 2015, we collected 61 unique taxa from 4 stream sites. Based on the aquatic macroinvertebrate communities, the Kishwaukee River was rated "excellent," Coon and Mosquito creeks were "good," and Spring Creek was "fair" (INHS 2016:7).

In 2017, we added the South Branch of the Kishwaukee River and collected and identified 52 taxa from 3 phyla (Annelida, Arthropoda, and Mollusca) across 5 sites. The Kishwaukee River was the only stream rated as "good" based on the macroinvertebrate community present. The South Branch of the Kishwaukee was rated as "poor" whereas Spring Creek, Coon Creek, and Mosquito Creek were "fair." Mosquito Creek was sampled closer to the roadway in 2017, which could account for the differences. Species richness and other metrics were lower in 2017 compared to 2015 at all sites. Rainfall was higher in summer 2017 than in 2015 and could have contributed to macroinvertebrate differences between years. Unfortunately, we did not have macroinvertebrate samples before construction, so we could not assess whether construction activities impacted the streams (INHS 2018:5).

Hydropsychid caddisfly larva

Fish

In 2015, we sampled 12 sites along I-90 that were initially sampled in 2012, before construction. The sites were the Kishwaukee River, 9 streams classified as "small stream crossings," and 2 "large stream crossings." We encountered 46 of the 192 fish species native to Illinois, including the state-listed Iowa Darter. We encountered 27 species within small streams and 23 species within large streams. Only 1, the Pumpkinseed, is classified as intolerant of poor water quality. The Kishwaukee River contained 30 species of fish, including the state-listed Gravel Chub. Four species classified as intolerant of poor water quality were found: the Banded Darter, Slenderhead Darter, Carmine Shiner, and Black Redhorse. There was no significant difference in species richness, community evenness, and species diversity compared to our 2012 samples (INHS 2016:8).

We re-sampled fish communities in 2017 after construction was completed and observed 45 species, including the state-listed Iowa Darter. We collected 24 species in small streams, 25 species from large streams, and 32 species in the Kishwaukee River. We captured only 2 individuals of the state-threatened Gravel Chub in 2017 compared to 7 individuals in 2015, but we encountered 3 state-threatened American Brook Lampreys in 2017 compared to 1 in 2015 (INHS 2018:5).

Interstate 90

Our surveys have shown the I-90 Project corridor continues to have high-quality fish communities, and there were no significant changes in the fish communities pre- and post- construction. Additionally, the work was vital to our understanding of the Iowa Darters' distribution, which ultimately led us to propose downgrading the Iowa Darter from state-threatened to SGCN.

We conducted avian point count surveys at Ipsen Road and Lib Conservation areas from 2015–2017 in the fall and spring each year beginning with fall 2015. The 2 sites along I-90 near the Kishwaukee River provide wetland, shrubland, and forest habitats for migrants and breeding birds. In fall 2015, we detected 61 species, including 3 individuals of the state-endangered Osprey (INHS 2016:11). In the spring and summer of 2016, we detected 107 and 81 species, respectively, including 2 endangered and threatened species: Northern Harrier and a tern (INHS 2016:29). In the fall of 2016, we detected 3,065 birds of 76 species, including a state-endangered Northern Harrier (INHS 2017:10).

We surveyed Ipsen and Lib 6 times between May and October 2017. We detected 118 species in 2017, 79 at Ipsen and 89 at Lib, including 3 state-listed species: American Bittern, Black-crowned Night Heron, and Osprey. We observed more hawk and owl species such as the Broad-winged Hawk and Great-horned Owl at Ipsen and more waterbird species such as the Virginia Rail and Northern Shoveler at Lib. We detected greater warbler diversity at Ipsen than Lib, with 12 species at Ipsen and 8 at Lib, opposite our 2016 findings where we detected 6 species of warblers at Ipsen and 10 at Lib (INHS 2018:5).

Over the past 5 years, we detected 147 species of birds at Ipsen Road and Lib Conservation areas, including 5 state-listed species: Northern Harrier, Osprey, American Bittern, Black-crowned Night Heron, and a tern. While we did not have data from pre-construction, we know post-construction, that the area supports a diversity of birds comparable to other conservation areas in the Chicagoland region.

Black-crowned Night-Heron

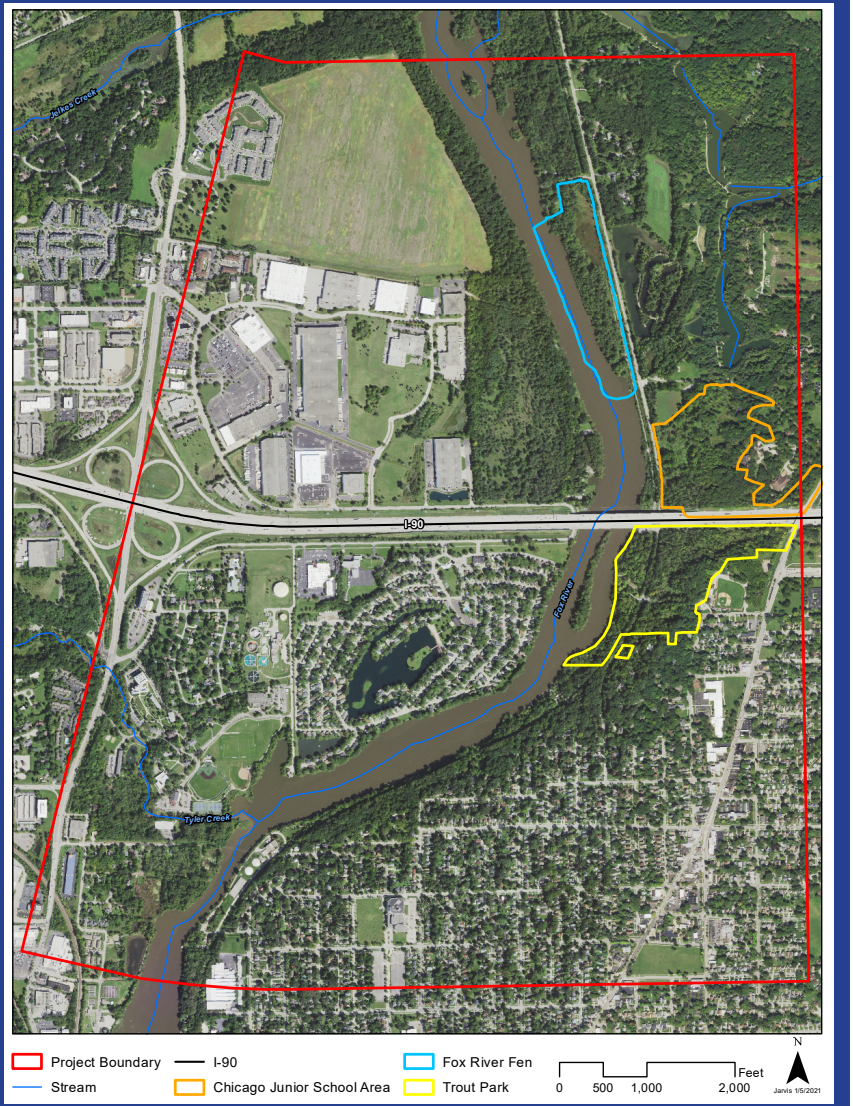
Bats

In 2016, we deployed acoustic monitors at 4 stream crossings in May, July, and September. We recorded over 15,000 bat passes, of which 10,566 were identified by software. Nine species of bats were detected: Big Brown Bat, Hoary Bat, Eastern Red Bat, Silver-haired Bat, Little Brown Bat, Tri-colored Bat, Evening Bats, and 2 federally listed species: the NLEB and Indiana Bat.

Species richness was highest during May when 8 species were detected at Spring Creek. Bat activity in July was higher than in May or September, with the highest activity in July at Mosquito Creek. The Indiana Bat and NLEB were detected at 2 of the 4 sites: Mosquito Creek and Spring Creek, during May and July.

While acoustic monitoring can provide reasonable assurances of species present, mist netting and DNA samples are recommended to verify presence, especially if making management recommendations for federally listed species (INHS 2017:8).

Jane Addams Memorial



Trout Park Complex

Trout Park, Fox River Forested Fen Nature Preserve, and Voyageur Landing Forest Preserve (collectively, Trout Park complex) are 3 woodland habitat patches running ~25 ha along the Fox River at I-90. The fen system is a significant habitat in Illinois with a relic aquatic macroinvertebrate community representative of more northern habitats. The Trout Park Complex and the Fox River watershed have great potential for habitat improvement and restoration. The new I-90 bridge over the Fox River was designed to allow water to run off into a single detention area, which acts as a filtration system to protect the sensitive wetlands from future degradation. Before the bridge replacement, we surveyed for mollusks, aquatic macroinvertebrates, amphibians, reptiles, and birds (INHS 2017:6). After completing the bridge, we deployed acoustic monitors to monitor bat activity at Trout Park (INHS 2018:4).

American Toad

Interstate 90

Dytiscid beetle larva

Mollusks

The Fox River, a tributary of the Illinois River, is a heavily modified stream, with many impoundments, and as such, the mussel community at this site is depauperate. We found 5 individuals of Giant Floater in the Fox River, and one common native snail, Liver elimia, was live and abundant along the river's edge. We also found an abundance of the non-native, invasive Chinese Mystery Snail. Habitat restoration (e.g., decreasing silt and addressing its source) at the site would be necessary for any further species recovery.

Aquatic Macroinvertebrates

We surveyed 2 springs and collected 32 taxa of aquatic macroinvertebrates, including 10 EPT taxa. We found the 2 springs did not differ in species composition despite differences in water chemistry (measured by Illinois State Geological Survey, Wetlands Geology Group). Aquatic macroinvertebrate species have been lost in springs of Fox River Forested Fen Forest Preserve and Trout Park Nature Preserve over several decades, and these sensitive communities could be threatened by environmental change in the future.

Reptiles and Amphibians

The amphibian and reptile populations in the Trout Park Complex are limited to common, tolerant species. We found 5 species of amphibians during our surveys, with the most abundant being 15 American Toads. We also encountered 6 Bullfrogs, 3 Green Frogs, 1 Northern Leopard Frog, and 9 Southern Leopard Frogs. We encountered 3 species of reptiles, 4 Spiny Softshell Turtles, 3 Painted Turtles, and 1 Red-Eared Slider. No snakes or salamanders were documented during our surveys, but management for a diversity of habitats with heterogeneous structure could encourage the persistence of amphibian and reptile populations at the site.

Birds

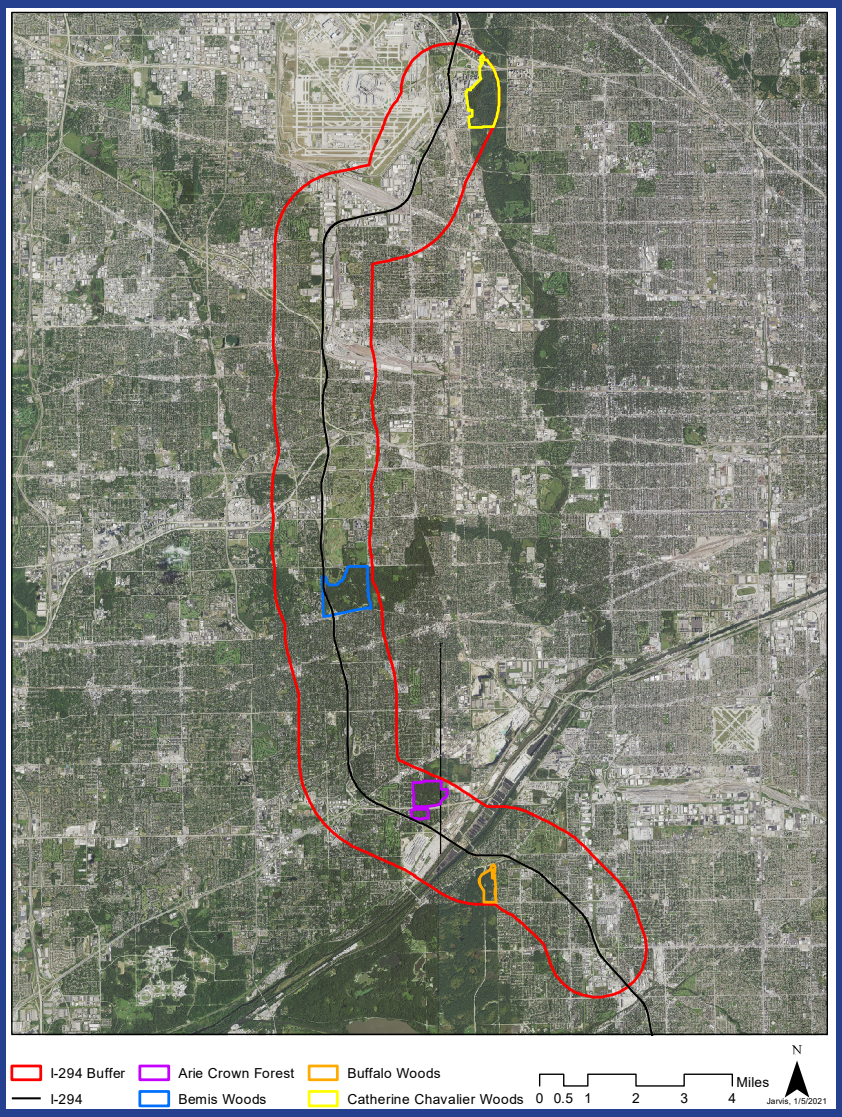
The most common bird species detected include resident species such as Cedar Waxwings, American Robins, and Red-winged Blackbirds. We also observed multiple species of migratory warblers and one Osprey, an endangered species, flew over during our surveys. Trout Park serves as important stopover habitat for migrants and contains higher avian diversity relative to similar urban forested areas.

Bats

Acoustic monitors were deployed for 28 nights during May, July, and September, with the highest bat activity in July. Software identified calls of 4 species: Hoary, Big Brown, Eastern Red, and Silver-haired bats. No calls from Trout Park were identified as NLEBs or Indiana Bats, possibly due to its proximity to highly urbanized areas. Our findings indicated the site is mostly used during the summer maternity season rather than during migration. Improvements to the habitat, reducing invasive shrubs in the forest understory, and increasing connectivity between forest patches could increase bat occupancy (INHS 2018:4).

Osprey

Tri-State Tollway

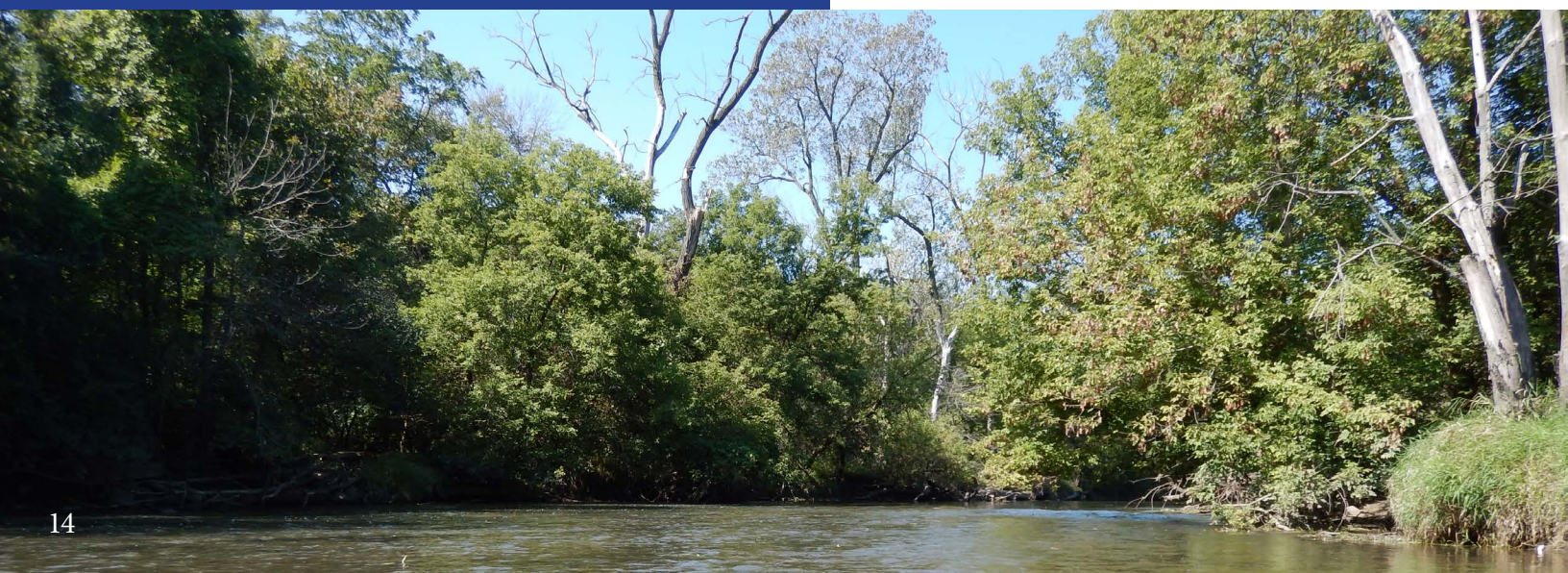


Tri-State at a Glance:

- *84 mile segment of road with 600,000 vehicles/day*
- *57 listed species*
- *4 federally protected*
  - *Rusty Patched Bumble Bee*
  - *Eastern Massasauga*
  - *Eastern Prairie Fringed Orchid*
  - *Northern Long-eared Bat*

The Tri-state Tollway is 84 miles long and runs along I-80, I-294, and I-94 from the Indiana border to the Wisconsin border and carries over 600,000 vehicles per day. The Central Tri-state is a 28-mile stretch along I-294 from I-55 to the junction with I-94.

Along the Central Tri-state (I-294), construction is planned to widen the tollway and replace aging infrastructure from Balmoral south to 95th St. with many species potentially impacted. The Mile Long Bridge will be replaced with 2, 5-lane bridges to increase capacity. Crossing over environmentally sensitive waterways, economically vital railways, and industrial areas, the new bridges are being constructed with fewer piers leading to fewer instream impacts. The construction also includes many smaller overpasses and streams. We conducted widespread surveys in 2015, during the planning stages for the construction. We assessed birds, mussels, fish, and aquatic macroinvertebrates in the corridor. We returned in 2018 to conduct targeted surveys for previously recorded endangered and threatened species based on the preliminary surveys.



Interstate 80/94/294

Mollusks

In 2015 we surveyed 6 stream crossings for mussels and encountered 31 live individuals of 3 species. Giant Floater was the most abundant, comprising 29 of the individuals. In Flag Creek at Cochise Dr., we found 28 Giant Floaters, 1 Paper Pondshell, and 1 Lilliput. In Salt Creek we found 1 individual Giant Floater and 1 species of native snail alive and abundant, Liver Elimia. The invasive Asian Clam was present at most of the stream sites. No rare species of mussels would be likely impacted by construction (INHS 2016:5).

Giant Floaters, Paper Pondshell, Lilliput

Heptageniid mayfly larva

Aquatic Macroinvertebrates

In 2015 we surveyed 7 stream crossings in the I-294 corridor for macroinvertebrates. Salt Creek, downstream of the I-294 crossing, rated as "fair" based on the macroinvertebrates present, while all other crossings rated as "poor." Three genera of mayflies, species intolerant of poor water quality, were found at 2 sites in Salt Creek and 1 site in Willow Creek. Most of the sites were rated as "poor" based on habitat conditions, with characteristics of habitat degradation common in urban watersheds, including a silt substrate and lack of stabilizing cobbles and boulders. Salt Creek at I-294 rated the highest based on habitat condition at "fair," owing to its cobble/gravel substrate and forested bank. Construction is unlikely to impact the diversity of macroinvertebrates found in these streams (INHS 2016:6).

Tri-State

Fish

We surveyed 6 stream sites for fish in 2015 and found 18 native species and 1 exotic invasive species: the Oriental Weatherfish. The most abundant species found were Fathead Minnow, Bigmouth Shiner, and Largemouth Bass, all of which are at least intermediately tolerant of poor water quality. We did find 1 state-threatened Iowa Darter in Flag Creek at Spring Rock Park (INHS 2016:4).

We returned in 2018 and conducted targeted searches of Flag Creek in all suitable and marginally suitable habitats for Iowa Darters. We documented 5 species but no Iowa Darters. If Iowa Darters occurred in the stream, they were not abundant. Raw sewage from combined sewer overflows is discharged into Flag Creek during high rain events; thus, Flag Creek is likely unsuitable habitat, and proceeding with construction was not likely to impact protected species (ME18-13).

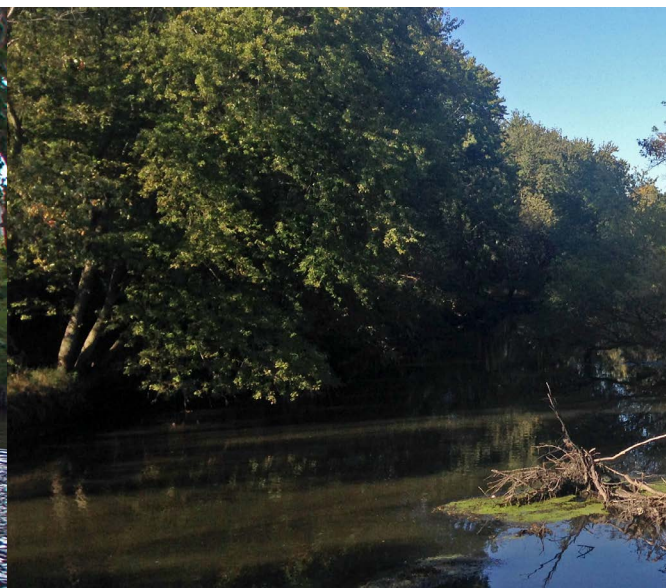
A Banded Killifish was recorded from the Chicago Sanitary and Ship Canal near the I-294 bridge crossing in 2014. We did not observe any suitable habitat for Banded Killifish, and based on our recent research, the Banded Killifishes inhabiting the area are the non-native subspecies to Illinois. Because of our research (see research section) and the recent, drastic increase in Banded Killifish populations in the region, we recommended no further action by the Tollway was necessary for the species (ME18-18).

Cerulean Warbler

Birds

In fall 2015, we monitored bird use in the forest preserves within the Central Tri-state corridor: Arie Crown, Bemis Woods, Buffalo Woods, and Catherine Chevalier Woods. Using visual and acoustic surveys, we detected 62 species, including 1 state-endangered species, a juvenile Northern Harrier at Bemis Woods (INHS 2016:3). In spring 2016, we added mist nets to our survey methods at Bemis Woods and detected 134 species in the corridor, including 1 state-threatened Cerulean Warbler and 7 species in greatest conservation need. The most abundant bird species were American Robins, woodpeckers, Indigo Buntings, and Northern Cardinals (INHS 2016:34). In the fall of 2016, we conducted point count surveys at Arie Crown and Bemis Woods, detecting 66 species of birds but no threatened or endangered species. The American Robin was again the most abundant species, accounting for 60% of the birds observed (INHS 2017:2).

Over the past decade, Ospreys have been observed nesting within 1 mile of the I-294 corridor. We conducted targeted surveys for Osprey nests in 2018 and found no active nests within 1 mile of the corridor. Three active nests were found 2.5–5 miles from the corridor. Ospreys may potentially nest closer to the corridor in the future (ME18-12).



Interstate 80/94/294

Bats

In 2017, we assessed the overpasses and surrounding habitat from Balmoral Ave. south to 95th St. to determine suitability for bats. We deployed acoustic monitors at several overpasses and detected NLEBs at Bemis Woods and Salt Creek. While we did not visually observe bats using the Salt Creek overpass, we recommended, if possible, for work to be conducted during the winter months to avoid potential impacts (ME17-02). We returned in 2018 to conduct emergence counts and acoustic recordings at the Salt Creek overpass and did not detect NLEB. Construction workers present had observed bats fly from the bridge previously, but it is unlikely NLEBs are roosting in the bridge as they prefer tree crevices, which are available in the adjacent Bemis Woods. We recommended avoiding additional lighting and loud, percussive work during the pupping season, 1 June through 31 July, when females need to catch large amounts of food (ME18-10).

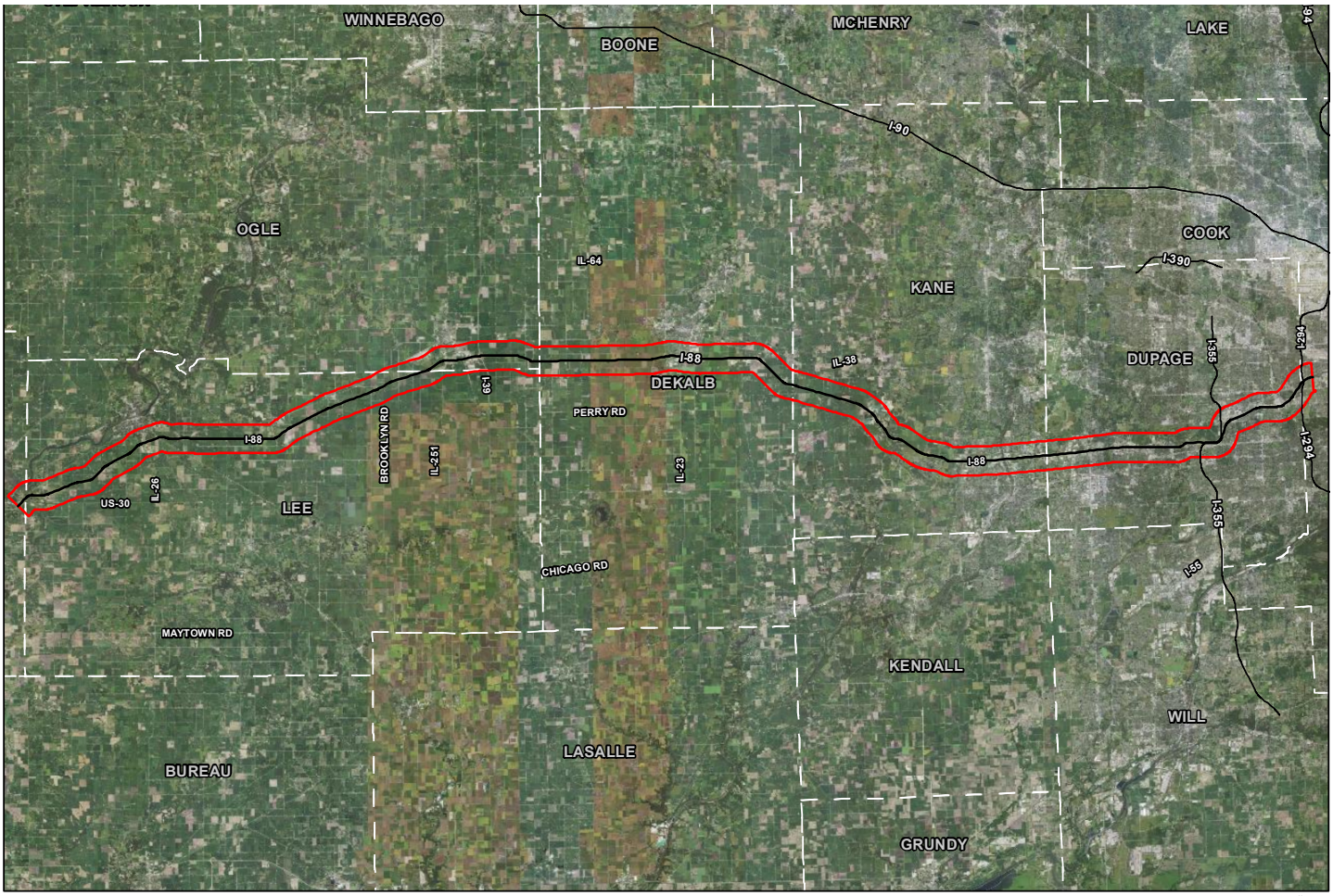
Bemis Woods

Running Juneberry

Plants

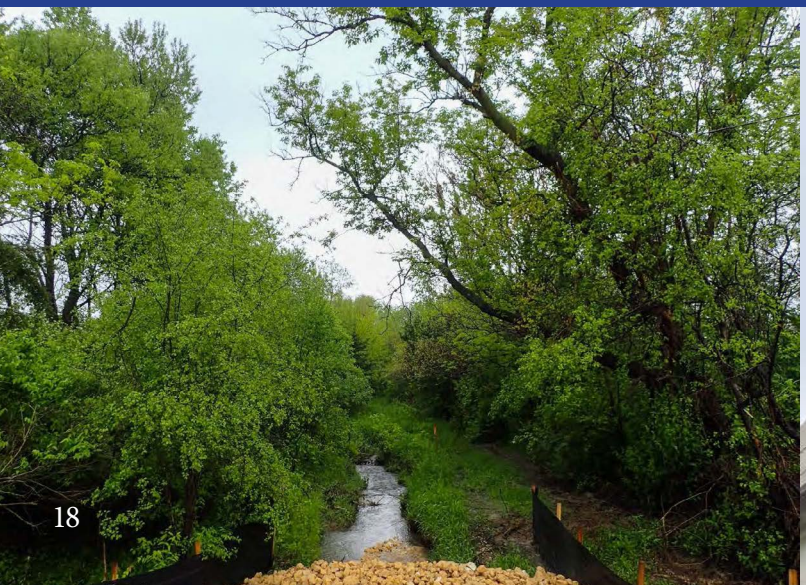
We found the project was unlikely to impact endangered and threatened plant species or high-quality habitat if conducted in the time frame and manner proposed. There were element occurrence records for the state-endangered Inland Juneberry in nearby Fullersburg Woods and Bemis Woods. After examining the records, our botanist determined they were misidentifications and consulted with DuPage and Cook County Forest Preserves staff and Natural Heritage Database staff to correct the records as the Running Juneberry, a nonprotected species. This correction will eliminate future concerns about this rare plant species being impacted by construction. If planned construction impacted Bemis Woods, additional surveys and precautions would be merited (ME18-11).

Ronald Reagan Memorial



Ronald Reagan Tollway At a Glance:

- *96 mile segment of road with 240,000 vehicles/day*
- *26 listed species*
- *2 federally protected:*
  - *Northern Long-eared Bat*
  - *Mead's Milkweed*



Interstate 88

Big Brown Bat under I-88 bridge

The Reagan Memorial Tollway (I-88) connects the Eisenhower Expressway (I-290) to Illinois Tollway's western terminus at Dixon, Illinois, and carries over 240,000 vehicles per day.

Proposed construction work included maintenance and repairs of roadways, bridges, and ramps. Additionally, roadway work included replacing a bridge over an abandoned railroad right-of-way, now part of the Illinois Prairie Path.

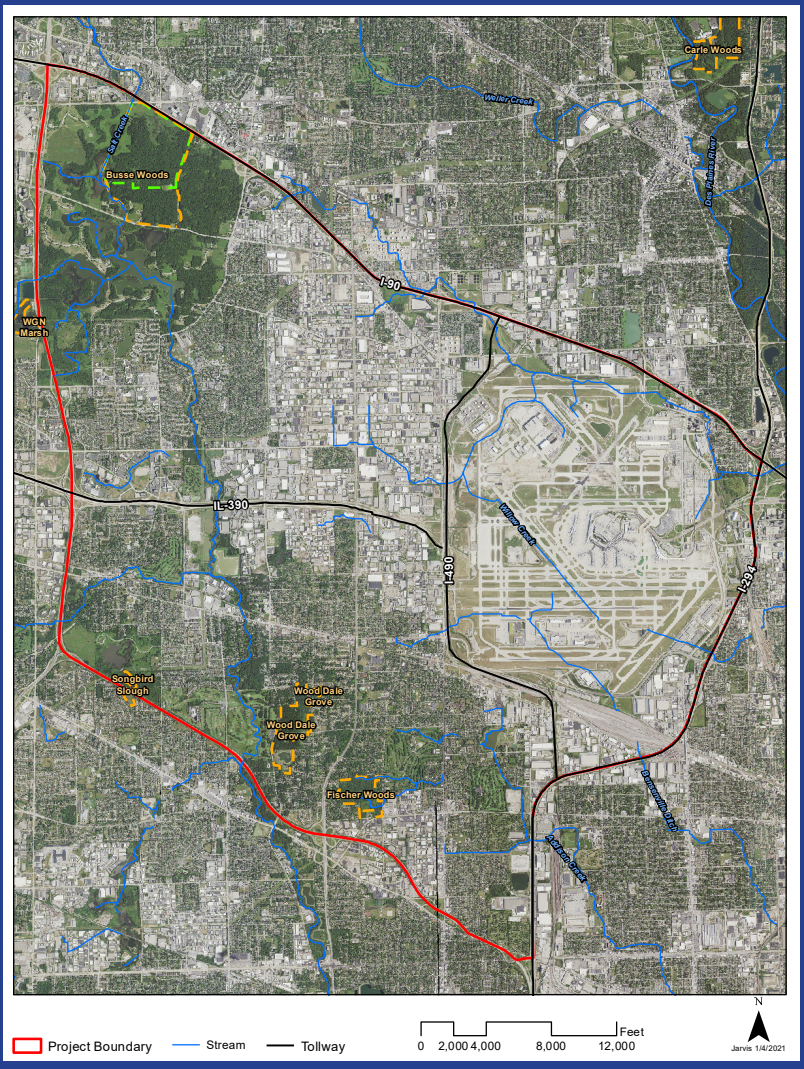
The only work we conducted during this period along this portion of the network was associated with bat roosting. The Tollway also planned to replace a second bridge over an abandoned railroad right-of-way closer to Dixon. Two federally listed species have occurrence records nearby: the NLEB and Indiana Bat. Because bats can roost under bridges, before replacement, we assessed the habitat for suitability. We found no trees with diameter at breast height (dbh) ≥ 3 inches and exfoliating bark in the immediate project area. We did find three trees with dbh ≥ 3 inches and exfoliating bark nearby. The bridge contained crevices that may provide bat habitat, but we detected no NLEB or Indiana bats during an emergence survey on 31 May 2017 (ME17-1).

Our findings indicated the proposed construction would have minimal impact on the 3 trees that could support bat roosts; thus, negative impacts to endangered bats were unlikely.

Elgin-O'Hare Expressway

Elgin-O'Hare at a Glance:

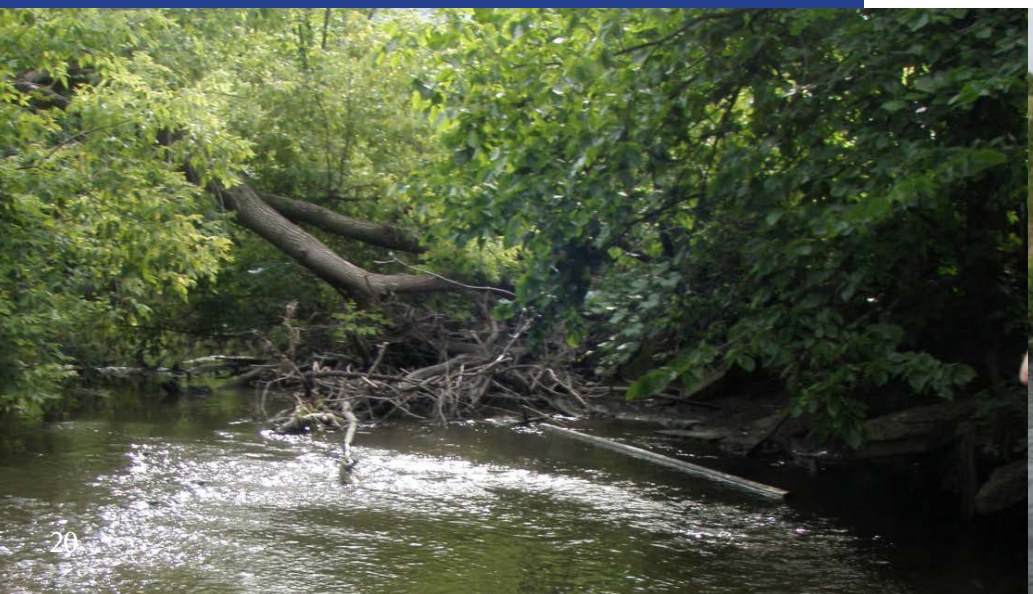
- *9.8 mile segment of road with 100,000 vehicles/day*
- *20 listed species*
- *One federally protected:*
  - *Rusty Patched Bumble Bee*



The Elgin-O'Hare West Access

The Elgin-O'Hare Expressway opened in 1993 under the purview of the Illinois Department of Transportation. The 9.8-mile expressway stretched from Lake St., Rte. 20 in Hanover Park, east to Thorndale Ave, and carries over 100,000 vehicles per day. In 2013, the Elgin O'Hare West Access Project (EOWA) was announced to connect the Elgin-O'Hare Expressway (IL-390) to O'Hare Airport and connect I-90 and I-294 via the new I-490 tollway. The Illinois Tollway took ownership of the corridor, and construction planning began. The 17 miles of proposed additional roadway would cross and potentially impact several streams (INHS 2017:9).

Many aquatic organisms are stream quality indicators; thus, in 2016, we sampled freshwater mussels, macroinvertebrates, and fish at 4 sites: Higgins Creek, Salt Creek-Thorndale Ave., Salt Creek-Salt Creek Forest Preserve, and Spring Brook. In addition to biotic samples, we collected environmental data at each of the sites.



Illinois 390 and I-490

Mollusks

We found 4 Giant Floaters and a live White Heelsplitter in Spring Brook. We encountered the non-native, invasive Asian Clam in abundance in Salt Creek and a recently dead shell of the non-native, invasive Chinese Mystery Snail in Higgins Creek and Salt Creek at Thorndale Ave. These species can survive in impacted streams and should not be adversely impacted by the planned construction.

Aquatic Macroinvertebrates

We followed IEPA sampling protocols for macroinvertebrates at the 4 sites in July 2016. We found between 6 and 19 different taxa at each site, primarily species tolerant of poor water quality. We found individuals representing 3 families of Ephemeroptera (mayflies), no Plecoptera (stoneflies), and 4 families of Trichoptera (caddisflies). Ephemeroptera-Plecoptera-Trichoptera (EPTs) are seen as indicators of water quality. Flatworms, amphipods, oligochaete worms, and chironomids were found at all sites. None of these species are indicative of high-quality streams. Using the Macroinvertebrate Index of Biotic Integrity, we rated Higgins Creek "poor" and the other 3 sites "fair."

White Heelsplitter and Giant Floaters

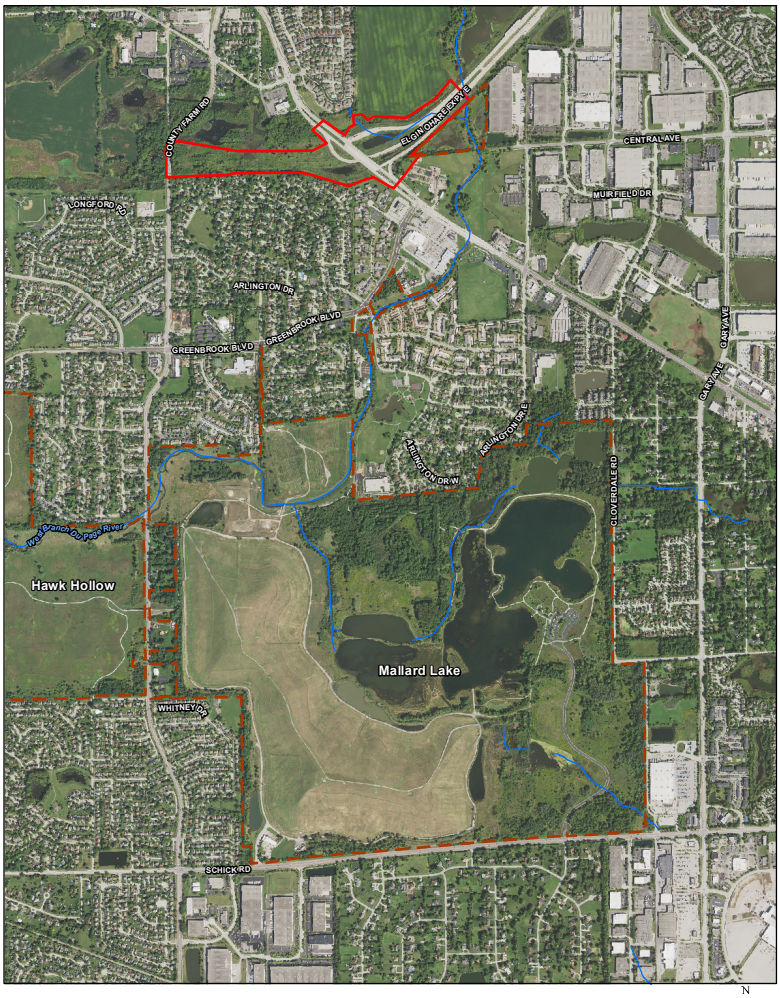
Amphipod

Fish

We conducted 10 fish community samples between July and September 2016 and captured 16 common species, all of which are at least "moderately tolerant" of poor water quality except Smallmouth Bass, which are "moderately intolerant." Our sampling efforts show the fish communities will likely not be largely affected by the tollway construction, and they will have similar assemblages post-construction.

The streams potentially impacted by the first phase of construction were of poor/fair quality and did not support any rare species. We were able to provide confidence that construction could proceed as planned without adverse environmental impacts.

Elgin-O'Hare Expressway



The Elgin-O'Hare Western Terminus

In 2018, the Tollway began a feasibility study to extend exit ramps from the expressway's current terminus at Lake St. (US-20) to Country Farm Rd. to decrease backups at the stoplight at Lake St. While the work scope would take place primarily within the roadway's right-of-way, the feasibility study included environmental, traffic, noise, and drainage impacts. We conducted targeted surveys for federally protected species and state-listed species with nearby EORs.

Rusty Patched Bumble Bee

Although there are no records for Rusty Patched Bumble Bee (RPBB) in the area, they are a federally protected species, so we surveyed for bumble bees and assessed habitat quality. We observed few bumble bees during our surveys and no RPBB. The area is highly disturbed and contains poor quality vegetation unlikely to support RPBB, which prefer to forage on flowering prairie plants, specifically Bee Balm/Wild Bergamot. We concluded it was unlikely that the proposed project would adversely impact RPBB populations in the region (ME18-17).

Little Yellow Sedge

Green Yellow Sedge

Illinois 390 and I-490

Red-Eared Slider and Painted Turtle

Reptiles and Amphibians

Blanding's Turtles are known from wetlands near the area of proposed construction. We captured 78 turtles but no Blanding's Turtles during sampling. The large size of some of the wetlands and our limited sampling window could have confounded our detection efforts, but most sites were heavily disturbed and did not provide the necessary habitat characteristics for Blanding's Turtles. As such, it is unlikely that the proposed project would have adverse impacts on the Blanding's Turtle population (ME18-16).

Bats

During the summer months, the federally protected NLEB roosts under peeling bark or large tree cavities and crevices. We surveyed the proposed impact area for potential roost trees for the NLEB. Most of the area was unsuitable roosting habitat, and if trees were removed during the winter (while bats are hibernating elsewhere), there would likely be no impact on the bats. A few suitable roost trees existed on private property outside of the construction zone; thus, we recommended that if tree removals occurred during the active season, spring-summer emergence surveys and acoustic monitoring should be conducted (ME18-15).

Plants

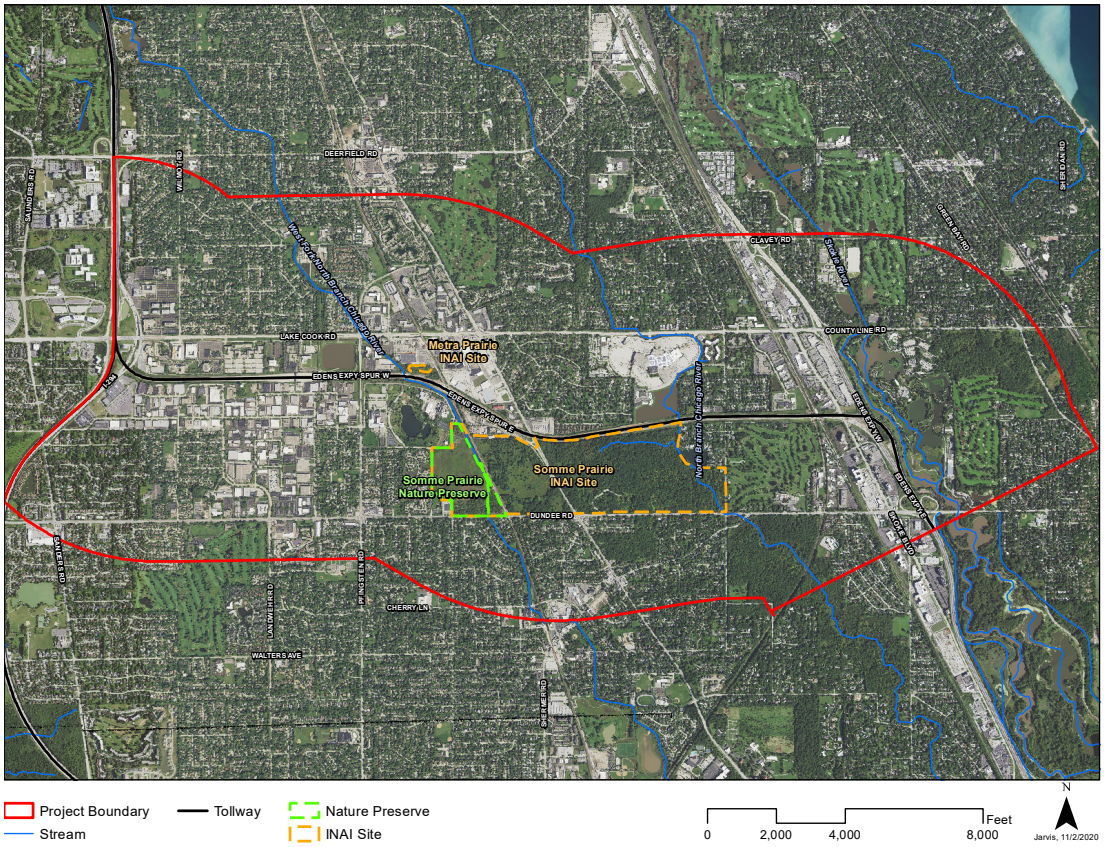
Two rare plants, Small Yellow Sedge and Green Yellow Sedge, have been reported at nearby Mallard Lake Forest Preserve (MLFP), prompting botanical surveys. MLFP is separated from the tollway right-of-way by topographical features and existing development. While we confirmed the continued existence of both species at MLFP, no rare plants were found within the proposed construction area. It is unlikely that the proposed project would impact any rare plant populations (ME18-14).

Our recommendations to the Tollway enabled them to proceed through their feasibility study with the confidence that their proposed construction would not impact protected species.

Edens Spur

Edens Spur at a Glance:

- *4 mile segment of road with 57,000 vehicles/day*
- *23 listed species*
- *3 federally protected:*
  - *Rusty Patched Bumble Bee*
  - *Eastern Prairie Fringed Orchid*
  - *Massasauga*
- *Crosses two INAI sites*
  - *Somme Prairie*
  - *Metra Prairie*
- *Crosses two large streams*
  - *North Branch of Chicago River*
  - *West Fork of North Branch of Chicago River*



The Edens Spur, connecting the Edens Expressway and the Tri-state Tollway, was constructed in 1958 and carries 57,000 vehicles per day. From 2018–2020, construction on the Edens Spur (I-94) repaved the roadway and replaced five bridges to extend the road's life and improve the driving experience. The Edens Spur passes adjacent to Somme Prairie Nature Preserve, which has occurrence records for the federally protected RPBB and NLEB and state-protected Iowa Darter and American Slough Grass. While the construction work would be confined to the existing right of way, we conducted targeted surveys for these species before construction.

Because bridges over streams were being replaced, aquatic organisms in the West Fork North Branch Chicago River and the Middle Fork North Branch Chicago River could be impacted by construction activities. During mussel surveys, we encountered a Pondhorn from West Fork. This is the first documented record of the species in the Des Plaines River Basin.

Rusty Patched Bumble Bee

A RPBB was reported from Somme Prairie Nature Preserve, and it is possible individuals could forage along the Edens Spur on

Interstate 94

roadside flowers. We recommended limited roadside plantings of flowering species as bumble bees may avoid foraging adjacent to roadways where planting of flowering species is reduced—thus eliminating flight paths placing individual bees in the path of automobiles. Queen bees overwinter in burrows or crevices; therefore, we also recommended earthmoving activities be limited in the area during early spring when the queens emerge and begin building nests (ME18-9).

Fish

We conducted targeted surveys of the West Fork for the state-listed Iowa Darter but captured only 2 fish species, Bluegill and Green Sunfish, neither of which signal quality habitat for Iowa Darters. While Iowa Darters have been detected in the nearby Somme Prairie Nature Preserve, the habitat is drastically different than streams along the Edens Spur. We concluded construction was not likely to impact any protected fish species adversely (ME18-6).

Bats

Bats are often observed using bridge overpasses to roost and hunt insect prey. We deployed acoustic monitors along the Edens Spur near forested areas. We detected Big Brown Bats, Eastern Red Bats, and Hoary Bats, but we did not detect any *Myotis* species (bat genus containing the federally threatened Northern Long-eared Bat [NLEB] and federally endangered Indiana Bat). Although we did not detect protected bat species, we recommended that the Tollway avoid unnecessary tree cutting and removal during the pupping season (June 1–July 30) when trees may contain females roosting with nursing young. Much remains to be learned about the impacts of construction lighting and noise on bat populations (ME18-7).

Pondhorn

Big Brown Bat

Plants

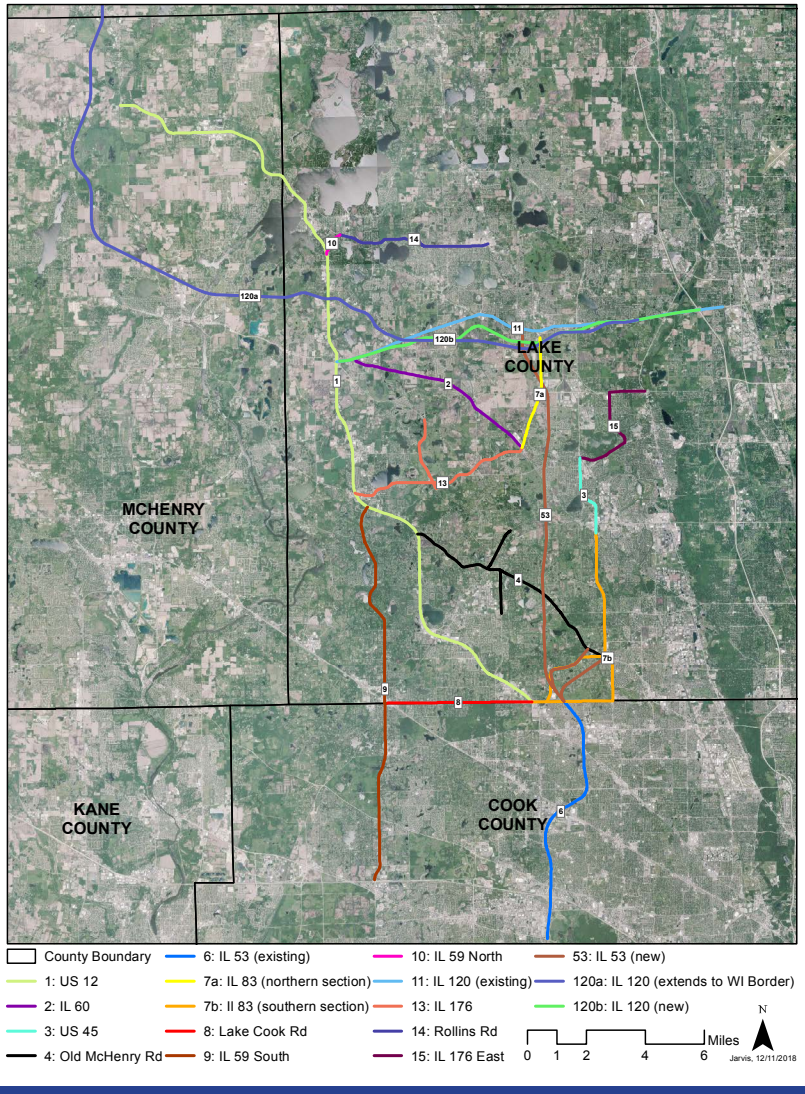
We conducted botanical surveys of the corridor but, while rare plants occur in nearby natural areas, the highly disturbed area abutting the roadway does not appear to support any sensitive species. Our surveys were conducted early in the growing season, so it is possible rare plants such as the American Slough Grass could be detected later in the season. However, it is unlikely that construction activities would impact any rare plant species (ME18-8).

We provided management recommendations, and increased confidence that the planned construction work would not adversely impact protected species.

Tri-County Access

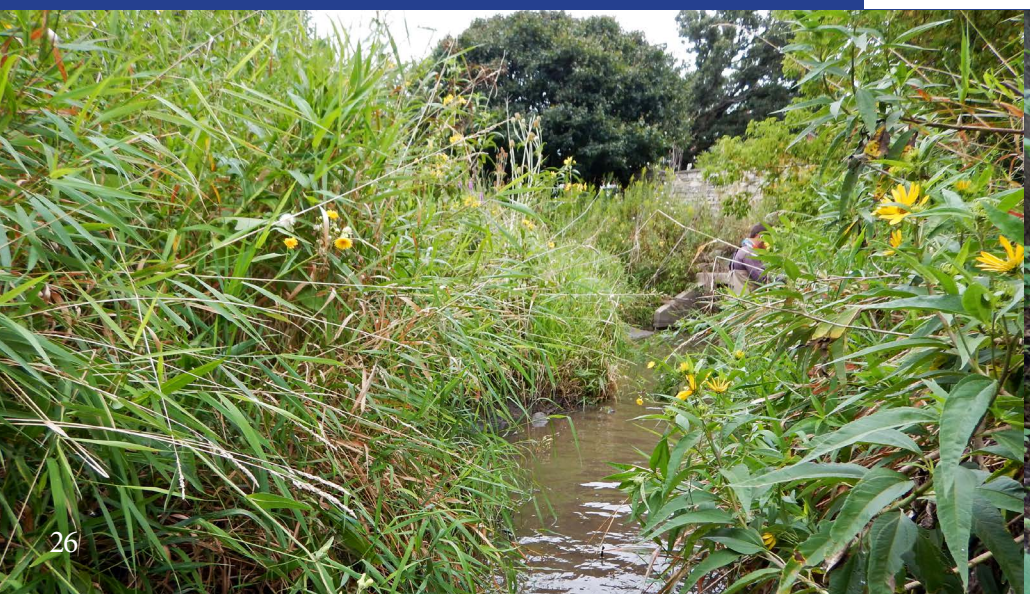
Tri-County Access Project at a Glance:

- *Addresses increase in population and traffic congestion in Lake, Cook, and McHenry Counties*
- *89 listed species*
- *3 federally protected known*
  - *Rusty Patched Bumble Bee*
  - *Northern Long-eared Bat*
  - *Eastern Prairie Fringed Orchid*
- *2 federally protected species possible*
  - *Black Rail*
  - *Hine's Emerald Dragonfly*



First conceived in the 1960s, the Tri-county Access Project (TCA) was proposed to address increased travel demands and ease traffic congestion associated with the continual expansion of urbanization in Lake, Cook, and McHenry counties. The proposed project included extending IL-53 and improving the IL-120 segment. The federally listed EPFO and RPBB have been found in this region. Although there were no current records, in 2019 the USFWS requested surveys for the HED and the Black Rail.

We conducted preliminary surveys in 2015 before segments were proposed. These surveys covered freshwater mussels, aquatic macroinvertebrates, turtles, birds, and plants. Once the Tollway had identified potential segments to achieve their goals, we analyzed the biotic resources, identifying stream crossings, natural areas, and EORs (INHS 2019:11). In 2019, we attempted to confirm the continued existence of these 470 EOR hits of 90 species and survey suitable habitat for other endangered and threatened species in the project area. The construction project was officially suspended in 2019, but our work continued to provide valuable information to the region's various stakeholders.



2015–2017

Mussels

Surveys published in 1898 reported 30 species of freshwater mussels in the Des Plaines River and its tributaries. In 2015 we sampled 14 sites in the Des Plaines River basin, Fox River basin, and Illinois River basin and found live individuals of 4 native species: Giant Floater, Lilliput, White Heelsplitter, and Fatmucket, all of which are common and tolerant of lower water quality. Decades of pollution and habitat alterations have led to declines in freshwater mussel populations and exotic invasive species. We found exotic invasive Zebra Mussels in Buffalo Creek and the Des Plaines River. We also found the exotic Chinese Mystery Snail at Countryside Lake (INHS 2016:14).

Aquatic Macroinvertebrates

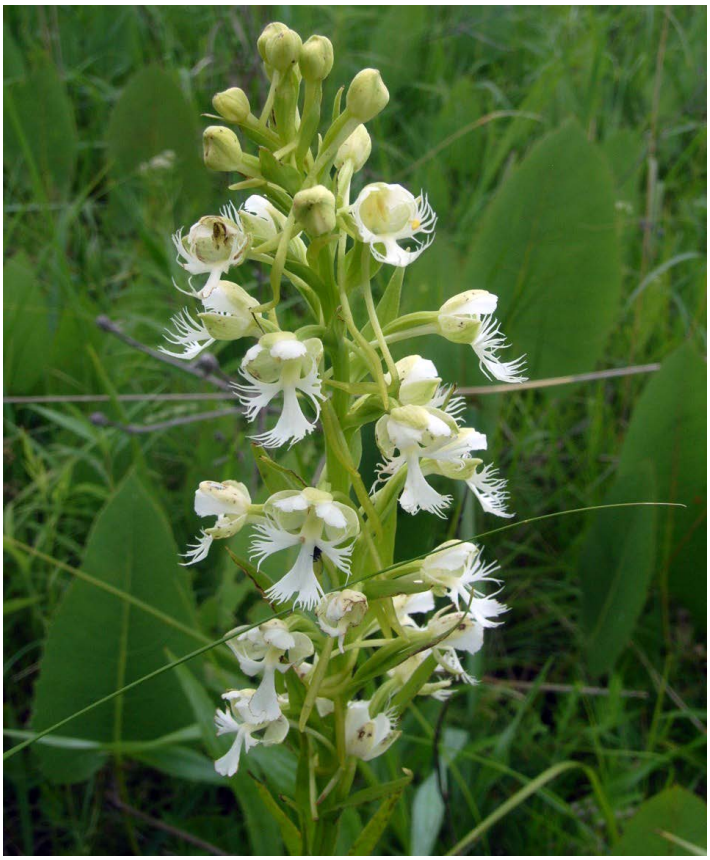
In 2015, we sampled aquatic macroinvertebrates at 9 sites and found between 8 and 19 taxa per site. We collected no stoneflies, and mayflies were absent from 3 of the 9 sites. Based on the macroinvertebrates, the Des Plaines River at IL-120 rated "good," Buffalo Creek at Tall Oaks Dr. rated "poor," and the other 7 sites rated "fair." The lack of diversity in the aquatic macroinvertebrate community and the low abundance of sensitive species indicate that these streams have been impaired through degradation and pollution (INHS 2016:15).

Birds

In 2015, we detected 104 species of birds during variable circular plot counts and intensive searches during the fall migration season. We detected 4 state-endangered Black-crowned Night-Herons: 2 at Almond Marsh Forest Preserve, 1 at Volo Village Hall Pond, and 1 at Heron Creek Forest Preserve. We conducted our surveys during fall migration and concluded that these sites provide stopover habitat for a diversity of the forest, grassland, and wetland species during migration (INHS 2016:10).

Eastern Prairie Fringed Orchid

During 2015, we evaluated 49 wetlands to determine if they warranted closer investigation for the federally threatened Eastern Prairie Fringed Orchid (EPFO). We identified 3 sites as meeting the USFWS criteria for closer inspection; however, no EPFO were located during follow-up surveys. We did confirm the survival of populations of 3 threatened or endangered plant species within the project area in 2015. EPFOs continue to occur within the Eastern Prairie Fringed Orchid Nature Preserve, south of IL-22. Also, Queen-of-the-prairie continues to occur in a single population near the EOR. Northern Green Rush continues to persist on the margin of an excavated pond in the area. Populations for two additional listed species were determined to be locally extirpated (INHS 2016:36).



Eastern Prairie Fringed Orchid

Tri-County Access

2018

In 2018, we received the proposed segments to be evaluated for the Environmental Impact Statement. We analyzed the landscape, nature preserves, publicly owned lands, stream crossings, wetlands, and EORs within 1 mile of each of those segments. The analysis enabled us to plan the necessary surveys to be conducted in 2019. There were 470 EOR hits of 90 species and rookeries within 1 mile of any segment; 84 records (30 species) were within the past 15 years. There were nearly 300 acres of Illinois Nature Preserve Commission sites, 215 acres of state parks, and 1,600 acres of county forest preserves within 175 m of any segment. There were over 300 acres of High Probability Zone for the federally listed RPBB and nearly 1,300 acres of Low Probability Zone, within 175 m of any segment. Over 360 acres of woodlands could support the federally endangered NLEB within 175 m of any segment (INHS 2019:11). In a series of roundtable meetings, we shared our survey plans with several sets of key stakeholders from the ISTHA and their consultants, IDNR, USFWS, USCOE, Lake County Forest Preserve District, and McHenry County Conservation District.

Net spinning caddisfly larva

Flutedshell

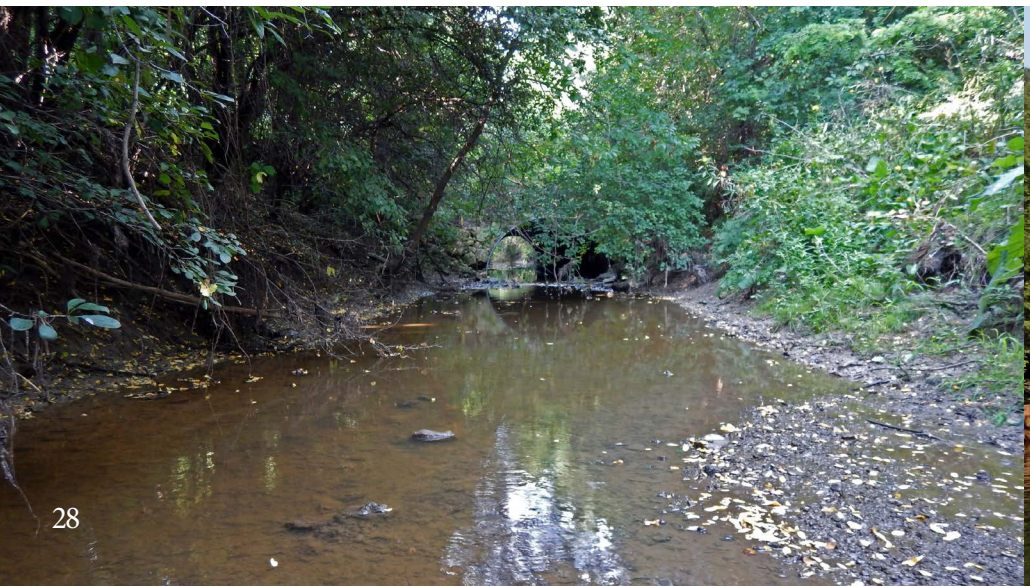
2019

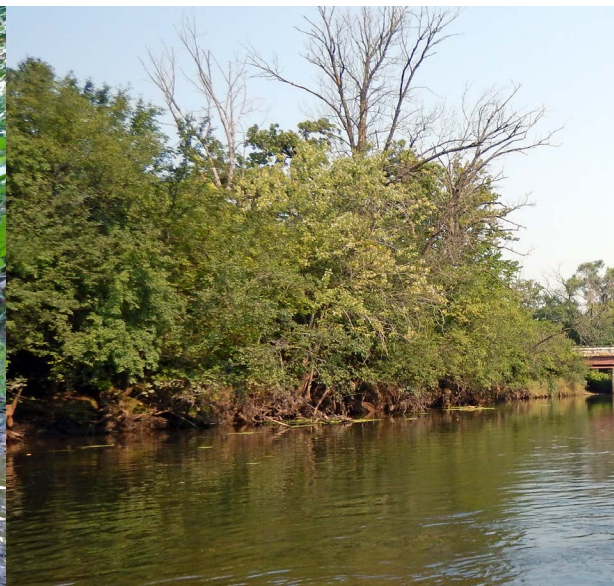
Mussels

There were 2 EORs for the Black Sandshell and Rainbow within 175 m of any segments. In 2019, we surveyed 14 sites in the Fox River and Des Plaines River basins. We encountered 17 of the 21 mussel species historically present in Nippersink Creek and the North Branch of Nippersink Creek. We confirmed the continued presence of Black Sandshells and added a record for a Spike and 3 SGCN: Elktoe, Flutedshell, and Creek Heelsplitter. The Nippersink basin continues to be one of the most diverse and intact mollusk streams in the state; thus, construction impacting the area has the greatest potential impact on the mollusk community (INHS 2020:1).

Aquatic Invertebrates

While there were no known EORs for aquatic macroinvertebrates, we sampled 8 sites in 2019 and found between 10 and 27 taxa per site. We found 2 SGCN, 1 Watch List caddisfly, and 3 rare caddisflies. Based on aquatic macroinvertebrates, 3 sites rated "fair" and 5 rated "good." We visited Spring Grove Fen and Horsehair Fen during the HED flight season. These fens contained similar habitat to known sites, and while we did not observe any adult HED, we recommend that these sites be considered as potential habitat.





Rusty Patched Bumble Bee

We added surveys for the federally endangered RPBB at Volo Bog and Glacial Park. We observed 620 individual bees of 10 species, including RPBBs and 2 SGCN: American Bumble Bee and Half-black Bumble Bee. Most bees were foraging on Wild Bergamot, while others were using Crown Vetch and Common Milkweed. Our surveys continue to add to the knowledge of RPBBs and enable the Tollway to make decisions that avoid negative impacts.

Brown-belted Bumble Bee

Fish

We surveyed 36 sites for endangered and threatened fish species. We found the state-listed Banded Killifish, Blacknose Shiner, and Iowa Darter in lakes and streams along US-12.

Blackchin Shiners and Starhead Topminnows have been found recently at sites along US-12, including Lake Zurich, Bangs Lake, Nippersink Creek, and Pistakee Lake. Construction activities along US-12 or IL-176 could be detrimental to endangered and threatened fish in the region.

Spiny Softshell Turtle

Reptiles

We trapped turtles at 11 natural areas for 1,208 trap nights, and we captured 3 Spiny Softshells, 136 Common Snapping Turtles, 401 Painted Turtles, 16 Blanding's Turtles, and 4 Red-eared Sliders. We confirmed EORs for Blanding's Turtles at Glacial Park, North Branch, and Grant Woods. Collaborators with the Lake County Forest Preserve District and McHenry County Conservation District verified extant populations at Singing Hills, Cuba Marsh, and Nippersink Canoe Base. Glacial Park likely has 1 of the larger Blanding's Turtle populations in the state, and the proximity of IL-120 to wetlands puts Blanding's Turtles at risk of road mortality. Given the possibility of a sizeable population at Singing Hills, an extant population at Nippersink Canoe Base, and suitable habitat bordering US-12 near both sites, construction poses a high risk of increasing Blanding's Turtle mortality.

Iowa Darter

Tri-County Access

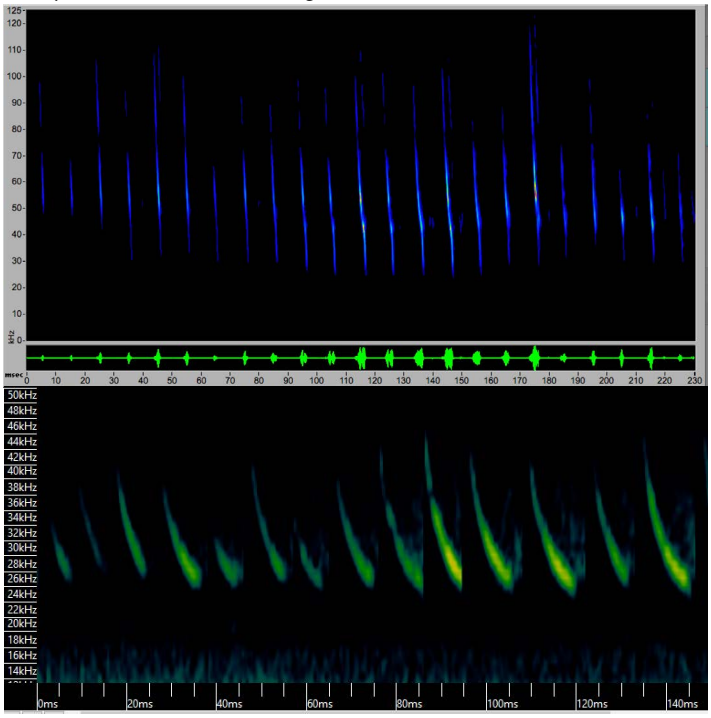
Yellow-shafted Flicker

Birds

We detected 132 bird species during point counts and playback surveys between April and October along the proposed segments. Of those, we detected 9 state-listed species: Least Bittern, Forster's Tern, American Bittern, King Rail, Common Gallinule, Osprey, Black-crowned Night-Heron, Common Tern, and Little Blue Heron. These wetland birds would benefit from protecting and improving existing wetlands in the region, including removing woody vegetation such as invasive buckthorn. Buckthorn removal would create larger patches of open water and improve emergent wetland vegetation growth needed by wading birds such as rails, bitterns, and herons.

Bats

We surveyed public lands in the region and counted 750 potential bat roost trees. From over 47,000 acoustic files, we detected 7 of the 8 potential bat species across 40 acoustic monitoring sites. The federally threatened NLEB was detected in recordings from 7 monitors in Deer Grove Forest Preserve, Crabtree Nature Center, Volo Bog, and Lakewood Forest Preserve. The closely related Little Brown Bat, which faces many of the same threats as NLEB, was detected at Glacial Park Conservation Area, and Grant Woods, Buffalo Creek, Grassy Lake, and Marl Flat forest preserves. We suggested that any work near these sites proceed with caution, avoiding unnecessary tree cutting and removal during the pupping season (June 1–July 30) unless an emergence count is conducted to verify the absence of roosting bats.



Top: Northern Long-eared Bat sonogram
Bottom: Big Brown Bat sonogram

Plants

In 2019, we confirmed 12 EORs of 9 rare plant species within the segments. Most of the rare plants were found in Wauconda, Gavin, Volo, or Pistakee Bogs. Bogs are a specialized habitat that are limited to the northeastern morainal region of Illinois. The remnants of our glacial history are habitat for many rare plant and animal species in Illinois, and disturbance should be avoided. We could not confirm EORs for the Small Cranberry, Showy Lady's Slipper, Highbush Blueberry, Two-seeded Sedge, and Mosquito Rush. Several species previously found at Pistakee Bog including Showy Lady's Slipper, Small Yellow Lady's Slipper, and Highbush Blueberry also could not be located during our 2019 surveys. Pistakee Bog has experienced high levels of invasion by exotic plants like Purple Loosestrife, which can easily displace populations of rare species. Management of exotic invasive species and avoidance of construction-related impacts would help these vital habitats.

Small Yellow Lady's Slipper Orchid

Tamarack

Marsh Speedwell

Mitigation Sites

Roadway construction is difficult to accomplish with zero impact on natural resources. To offset the impacts, the Tollway supports numerous mitigation projects throughout the region, including habitat restorations and removal and control of invasive species. Our biologists monitor these restoration projects to determine how plant and animal communities respond to restoration progress. Our expertise enables us to provide the Tollway with the data to maximize their benefit and impact per expenditure.

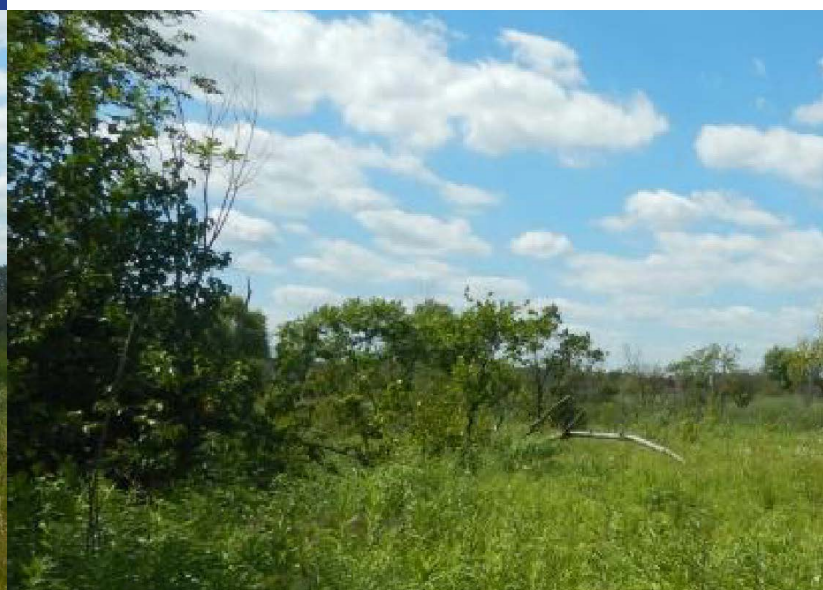
The North Chicago Wetland Mitigation Bank (NCWM) is a 160-acre matrix of remnant and restored wetlands initially purchased by IDOT and currently co-managed by IDOT and the Tollway. Both agencies have used the site as mitigation for road construction projects. Between 2009 and 2015, we monitored vegetation at the site to document changes over time in response to management (INHS 2010:07, INHS 2014:13, INHS 2016:28). We surveyed for aquatic macroinvertebrates, amphibians and reptiles, birds, and bats in 2016 and 2017 (INHS 2016:33; INHS 2017:01).

We sampled aquatic macroinvertebrates in 1 pond during summer 2016 using D-net sweeps to capture organisms and their accompanying organic and mineral material to be preserved and sorted in the lab. We found 11 taxa, including beetles, water bugs, scuds, crayfish, a leech, and 2 snail families, all of which are common in wetlands and ponds. These species are tolerant to variation and are not currently used to rate wetland quality.

We used visual encounter surveys, dip net sweeps, and aquatic trapping to sample amphibians and reptiles. We found 9 species, including the Blue-spotted Salamander, which suggests this site's importance as an urban habitat island. Two species we found, the Blue-spotted Salamander and Boreal Chorus Frog, were not encountered during surveys in 2007. Surveys conducted concurrently at a nearby property owned by Abbott Laboratory captured Smooth Greensnakes, another priority species. The state-endangered Blanding's Turtle was

North Chicago Wetlands at a Glance:

- *Co-managed by Illinois Tollway and Illinois Department of Transportation*
- *160 acres of remnant and restored wetlands*
- *We detected:*
  - *4 species of bats*
  - *SGCN Blue-Spotted Salamander*
  - *SGCN Brown Creeper*
  - *State-endangered Nothern Harrier*



North Chicago Wetland

not detected at NCWM; however, there is suitable marsh habitat, and though unlikely, they may occur at the site.

For our first bird survey, in spring and summer of 2016, we sampled birds along line transects, recording the species found along transects and their number and distance from them. We then estimated density, abundance, and species richness and diversity. We found 43 species using the transect method and 90 species in combination with additional intensive searches. During our fall resampling of the transects, we found 67 bird species, including the state-endangered Northern Harrier. We also detected the Brown Creeper, an SGCN. The site's species composition is highly overlapped with several nearby reference sites and included rare species not detected at the reference sites. Increasing canopy cover and maintaining snags at this site will benefit the bird community.

Brown Creeper

Silver-haired Bat

We surveyed for bats during fall using passive acoustic recording and analyzed the echolocation calls using 2 software programs. One program detected 4 species, Silver-haired, Eastern Red, Evening, and Tri-colored Bats, with surveys detecting upwards of 8 bat species in Lake County overall. Our failure to detect Big Brown, Little Brown, NLEB, and Hoary Bats, might be due to seasonal timing of sampling, declines due to WNS, or both. In most of our surveys, spring has the highest bat species diversity, and summer has the highest bat activity. The survey was conducted in the fall when species like NLEB are migrating to hibernation sites to mate. NLEB has also been severely impacted by WNS, which might be responsible for our failure to detect it. Lastly, the NCWM lacks the large tracts of contiguous forest that are preferred by NLEB.

Our results at North Chicago indicate the site provides important habitat for amphibians, reptiles, and birds. Increasing canopy cover and patches of woodland at the site might also support migrating bats. The results are especially significant given the site is an island surrounded by roads and urbanization.

Mitigation Sites

Orland Grasslands at a Glance:

- *Cook County Forest Preserve*
- *Restoration of 960 acres north of 179th began in 2002*
- *Restoration of 162 acres south of 179th began in 2014*
- *We detected:*
  - *7 bat species*
  - *2 state-listed birds*
  - *14 SGCN birds*
  - *1 SGCN bumble bee*

The Tollway has partnered with the Forest Preserve District of Cook County (FPDCC) to restore a new parcel to Orland Grasslands Forest Preserve. FPDCC began restoration at the site in 2002 and in 2014, restoration work began on 162 acres of former farmland as mitigation for the I-90 rebuilding and widening project. We conducted monitoring at the Orland Grassland South Addition Wetland Mitigation Site covering 6 taxonomic groups of aquatic and terrestrial fauna during the 2017 field season (INHS 2018:7).

We conducted a single survey of a small, unnamed tributary in the mitigation site for mollusks, using tactile and visual detection during a timed search. We found 2 snail species common to small, slow-moving, or stagnant water bodies, but no mussels. The stream is small, with a silt substrate more characteristic of wetlands; thus, it is unlikely mussels will colonize it.

To assess the aquatic macroinvertebrate community, we sampled 2 permanent ponds in the mitigation parcel and 5 ponds in the main Orland Grassland site. We used D-net sweeps to capture organisms and their accompanying organic and mineral matter. We identified 61 taxa across 3 phyla. Many taxa were shared across all the ponds in both locations, but we found differences between the macroinvertebrate communities at Orland Grassland South and the main site. The differences may be due to local environmental factors and dispersal.

We sampled fish in the main pond at Orland Grassland South using a minnow seine and electrofishing. We found 4 species, with Golden Shiner comprising 60% of the catch. All the species caught are tolerant of poor water and habitat quality and are predatory on amphibian larvae, which might depress amphibian colonization of the mitigation site.

We used visual encounter surveys, hoop nets, and minnow traps to sample amphibians and reptiles at the site. We also trapped in ponds at the main Orland Grasslands to compare

Orland Grasslands

older and newer restored sites. We detected 4 amphibian and 3 reptile species, all of which are common and tolerant of disturbance. Amphibian larvae were present in the newly restored ponds, but the predatory fish could impact the recruitment.

Most grassland bird species have declined for decades, and these species can benefit from grassland habitat restoration projects. We used avian point counts to survey the bird community, whereby we recorded all bird species seen or heard during 6 minutes along with weather and habitat information. We detected 77 bird species, including 2 state-listed species, King Rail and Northern Harrier, and an additional 14 SGCN. We found the bird community at the site was diverse and robust, with moderate species richness and high evenness values. Continuing the periodic prescribed burns will reduce the woody edge habitats used by parasitic Brown-headed Cowbirds, thereby helping declining bird species like the Henslow's Sparrow.

Dickcissel

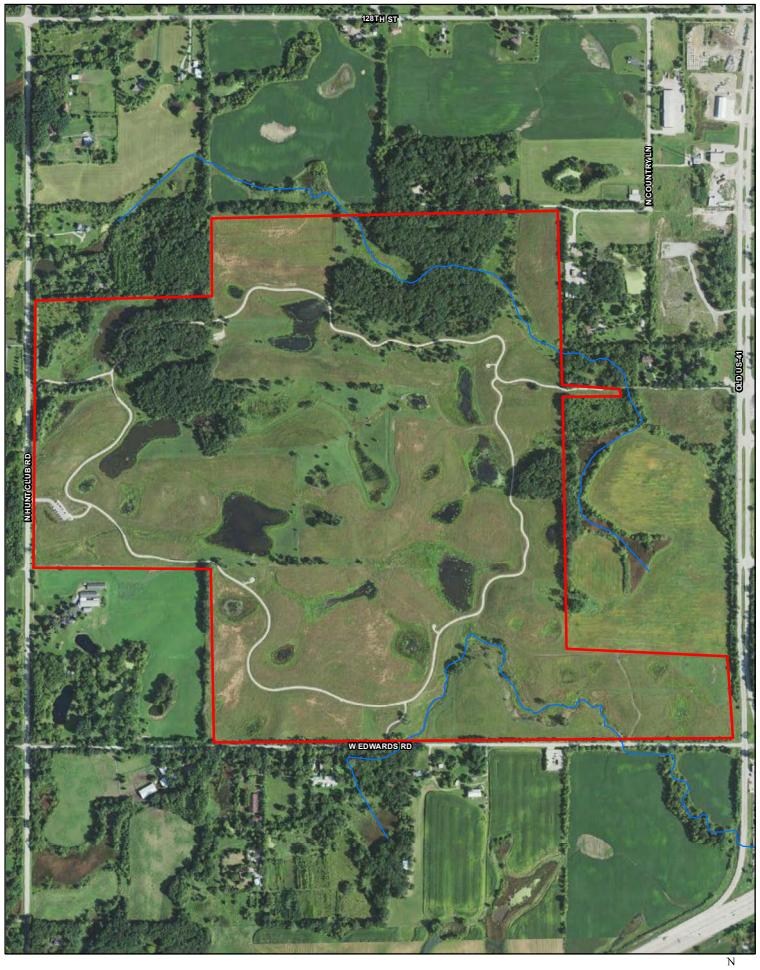
Golden Northern Bumble Bee

We used bioacoustics recorders to record bat echolocation calls at 2 stations during the spring, summer, and fall. After analyzing the resulting acoustic files, we documented 7 bat species, including the federally endangered Indiana Bat. However, because the Little Brown Bat has a very similar acoustic profile, we could not be confident of the Indiana Bat recording. The activity we recorded suggests bats use the site more often during their spring migration and summer maternity seasons than during their fall migration season.

In 2020, we conducted bumble bee surveys at Orland Grasslands. We did not encounter the Rusty Patched Bumble Bee, but did detect 8 species across the site, including the American Bumble Bee, an SGCN in the established prairie (INHS 2020:25).

Overall, our results suggest Orland Grasslands already provides habitat for sensitive bat and bird species, and with some management effort, it could benefit aquatic species. We will continue to monitor the site and compare the biotic communities to those at the more established Orland Grassland North.

Mitigation Sites



Pine Dunes at a Glance:

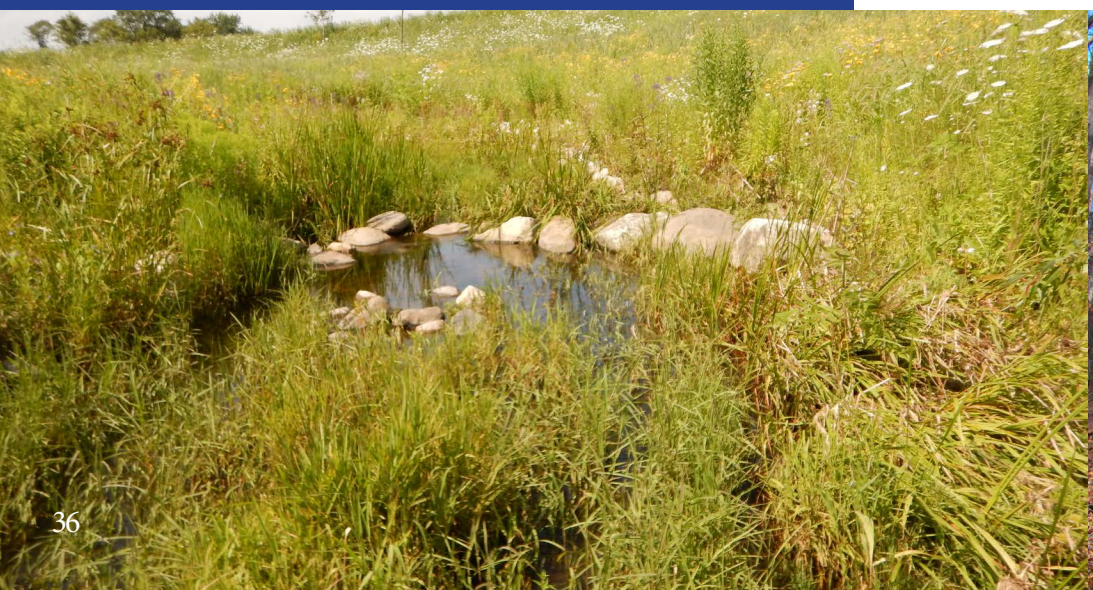
- *Lake County Forest Preserve*
- *868 acre site with 85 acres of wetland construction and enhancement*
- *SGCN Blue-Spotted Salamander*
- *SGCN Half-black Bumble Bee*
- *14 SGCN bird species*

Since 2014, the Tollway has been working with the Lake County Forest Preserve District (LCFPD) on an 868-acre restoration project at Pine Dunes Forest Preserve, near Antioch. The project includes approximately 85 acres of wetland construction and enhancement to mitigate impacts of the Elgin O'Hare Western Access Project. Additionally, the project will enhance adjacent upland natural communities. We conducted monitoring at the site in 2017 to help assess restoration performance metrics and goals (INHS 2018:8).

We sampled aquatic macroinvertebrates in spring and fall at 12 ponds using D-net sweeps to capture organisms and their accompanying organic and mineral material to be preserved and sorted in the lab. We identified 80 taxa across phyla Annelida, Arthropoda, and Mollusca. All major wetland aquatic insect orders were present at Pine Dunes, including Ephemeroptera, Odonata, Hemiptera, Trichoptera, Coleoptera, and Diptera. Wetland dwelling aquatic macroinvertebrates appear to be more tolerant to variation and are not currently used to rate wetland quality. These surveys serve as a baseline reference for future surveys to monitor colonization by species.

We used timed visual and tactile searches to sample a small, unnamed tributary for mollusks. We found 4 snail species but no mussels. The snail species we found are typical of a small, slow-moving stream and are likely early colonizers of a restored site due to their tolerance of disturbance and a wide variety of environmental conditions. The stream has a cobble and gravel substrate with encroaching vegetation, making it more of a wet prairie, and it is unlikely that mussels will colonize the site.

We sampled 4 ponds and a stream at Pine Dunes using a bag seine to assess the fish community. We found 4 fish species across 2 ponds and the stream, none of which indicate a healthy wetland or aquatic community. We suggest native species introductions in the 2 ponds containing fish to improve fish diversity. Blackstripe Topminnows, Central



Pine Dunes

Mudminnows, Golden Shiners, Grass Pickerel, Least Darters and Tadpole Madtoms are native to the Des Plaines River drainage and inhabit ponds similar to these. Their introduction would improve the fish community of Ponds #10 and #11. Other ponds should remain fish free to provide habitat for amphibians and macroinvertebrates.

We sampled amphibians and reptiles at 7 of the site's ponds in the spring, using minnow and turtle traps, and visual encounter surveys. We found 5 amphibian species in the ponds and observed Painted Turtles basking. Of particular note was the Blue-spotted Salamander, an SGCN and a priority species for Chicago Wilderness. The species has been negatively impacted by urban sprawl, and Pine Dunes Pond #2 appears to provide suitable quality breeding habitat. The forest habitat around Pond #2 should be maintained, and preventing pond colonization by fish should be prioritized.

Using point counts, we surveyed birds at Pine Dunes and a reference site, Illinois Beach State Park. We calculated metrics to assess the bird community from the data collected during these 6-minute observations of all species detected by sight and sound. We detected 119 bird species, including 2 state-listed species at Illinois Beach. We found 14 species of SGCN species at Pine Dunes. The 2 sites had similar species richness, but we calculated slightly lower evenness and diversity at Pine Dunes. Both sites appear to serve as essential habitat for both migrating and resident birds and highlight the importance of preserving large contiguous land patches— removal of invasive Reed Canary Grass and maintaining snags will benefit the bird species.

American Redstart

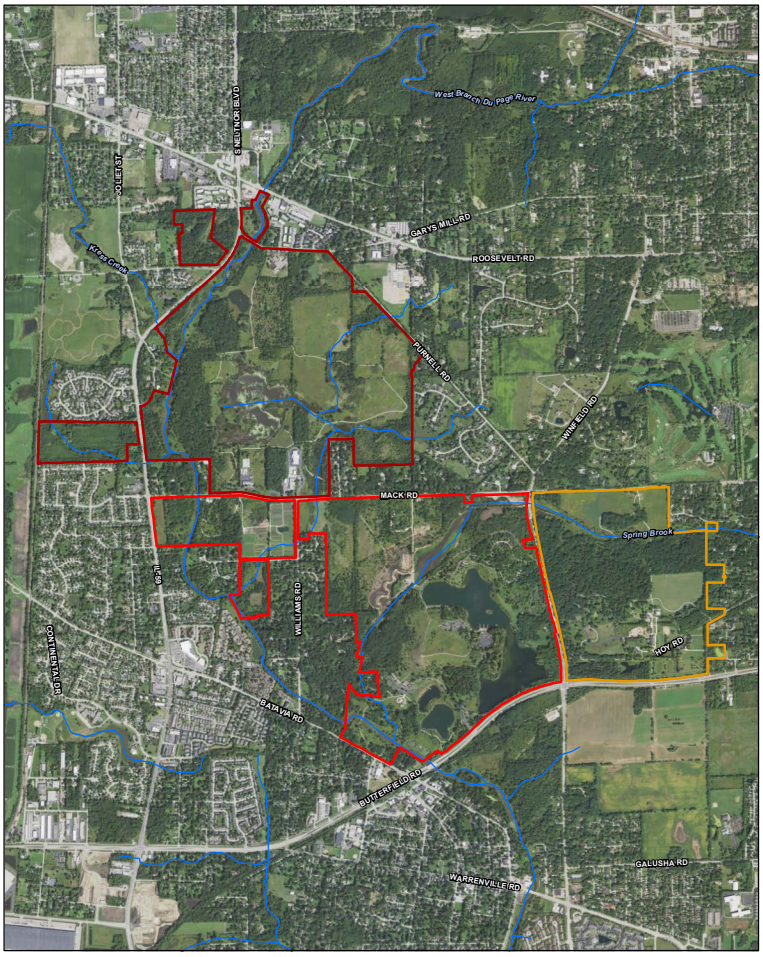
Blue-Spotted Salamander

We surveyed for bats using bioacoustics recorders to record echolocation calls at 4 sites during spring, summer, and fall. We identified 4 bat species, and the analysis suggested the Little Brown Bat might also be present. White-nose Syndrome (WNS) has heavily impacted the Little Brown Bat. Our results suggest bats use the site most often during the summer maternity season, making it an important site to help populations recover from WNS.

In 2020, we conducted bumble bee surveys at Pine Dunes. We did not encounter the Rusty Patched Bumble Bee, but did detect 8 species at the site, including the Half-black Bumble Bee, an SGCN (INHS 2020:25).

Based on our findings, we made management recommendations to support and improve the natural communities at Pine Dunes, including introducing native fish to some ponds while maintaining the other ponds fish-free, reducing invasive plant species across the site, and maintaining forest cover around ponds.

Mitigation Sites



Blackwell Forest Preserve at a Glance:

- *DuPage County Forest Preserve*
- *Phase I: restore meanders to Spring Brook No. 1*
- *Phase II: restore 1.3 mi of stream; remove dam*
- *Encountered 6 Rusty Patched Bumble Bees*

The Illinois Tollway is funding an extensive restoration at 2 Forest Preserve District sites in DuPage County: Blackwell Forest Preserve and St. James Farm Forest Preserve. The project is a multi-phase restoration of the Spring Brook watershed. The first phase, completed in 2015, restored meanders and connections to the floodplain of a half-mile section of Spring Brook No. 1 Creek. Phase II of the project, restoring a 1.3-mile stretch of the creek, began in 2019 and will be completed in 2021.This involved removing a low head dam, draining the impoundment it created, and providing fish and other aquatic life better upstream connectivity. Phase III will continue improving upstream habitat and water quality. In 2017, we conducted biological monitoring across 4 taxonomic groups of aquatic and wetland fauna at Spring Brook No. 1 and wetlands at St. James Farm Forest Preserve and Blackwell Forest Preserve in DuPage County (INHS 2018:1).

We sampled aquatic macroinvertebrates at 7 sites across all 3 phases of the Spring Brook No. 1 Project area, using the ILEPA 20-Jab Allocation Method for wadable streams to collect organisms along with their associated organic and mineral material. We identified 53 taxa of macroinvertebrates, 38 of which were arthropods. The other phyla represented included flatworms, annelids, and mollusks. The most abundant taxa were simuliids (blackflies) and chironomids (nonbiting midges). Water quality scores calculated from the macroinvertebrate samples ranged from "fair" to "poor" across the sites. We concluded that additional restoration efforts might be needed to establish a stable, high-quality macroinvertebrates community.

We sampled mollusks in all the streams of the project area using visual and tactile detection during timed searches. After collection, we identified individual species and demographic characteristics for both live and dead animals, and we used this information to calculate metrics describing the mollusk community at the site. We found 2 live native mussel species during our surveys. We also noted the presence of 2 invasive species within the project area: Asian Clam and

Blackwell Forest Preserve

Chinese Mystery Snail. Overall, species diversity, evenness, and richness were poor. The low head dam's presence likely has negatively impacted the mollusk community.

We conducted passive fish sampling using hoop and minnow traps at 3 locations once a month during the field season. We collected 8 fish species, but Western Mosquitofish comprised approximately 3/4 of the fish collected. We found higher species diversity and evenness in the stream compared to the lake. Based on our sampling at the site and the nearby West Branch of the DuPage River, we felt that the restoration could improve local fish communities on a regional scale.

We trapped amphibians and reptiles, using hoop nets and minnow traps, in restored wetlands adjacent to the Phase I stream restoration and the lake in the Phase II Project area. We identified and released the animals we captured, marking them for identification on recapture. Species captured included 3 frogs, 3 turtles, and 1 snake caught incidentally. We heard an additional frog species, Western Chorus Frog, calling from the site, but did not capture it. We captured predatory Green Sunfish in 2 of the wetlands, which could mean these sites are unsuitable for colonization by additional amphibian species.

Rusty Patched Bumble Bee

Giant Floater (top) and 3 White Heelsplitters (bottom)

In 2020, we conducted bumble bee surveys at Blackwell Forest Presrve. We encountered 7 species including the Rusty Patched Bumble Bee in the Phase 1 mitigation and 8 species total across the preserve, including the American Bumble Bee, an SGCN, at McKee Marsh (INHS 2020:25).

Overall, our results indicated that the restoration site has the potential to benefit aquatic communities, but some targeted restoration efforts might be needed to support colonization by native species and mitigation of invasive species. We will continue to monitor the site as the dam removal during Phase II may enable colonization by additional species.

Associated Research

Besides environmental assessments supporting construction and mitigation projects, we conduct research to help the Tollway better understand the current biodiversity in their network. We have also successfully leveraged our contract with the Tollway to secure numerous grants supporting biotic research in the Tollway region. We have received over $1.75 million during the past 5 years from the USFWS, state natural resource agencies, forest preserve districts, and NGOs.

Freshwater mussel health assessment in an urban stream system (Des Plaines River basin) in northern Illinois.

Minimal information exists about general freshwater mussel health, with several studies focusing on impacts from wastewater treatment effluent or dams (impoundments). Our study records general mussel health parameters in a highly urbanized system (Des Plaines River basin) to determine reproductive health and body condition in the Giant Floater and White Heelsplitter, common mussel species. Our work's second objective is evaluating parasite loads, particularly for sterilizing trematodes commonly found in mussels. Environmental parameters are recorded at all study sites to assess abiotic and biotic factors influencing health in native mussels. We sampled opportunistically in 2018 and 2019, but often the number of animals needed for a sample (non-lethal and lethal) at a site did not meet our threshold. We collected samples from 3 sites in 2 streams in 2018 and 1 site in 2019. Results from this study will contribute to a growing body of literature on freshwater mussel health.

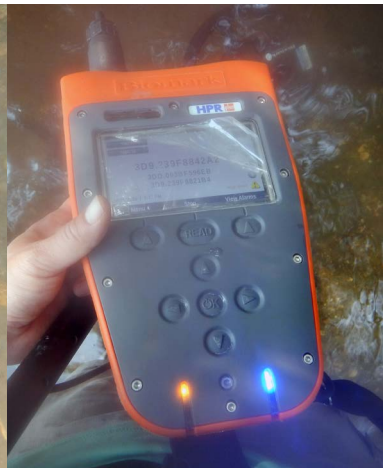
Translocated mussels

A commonly employed measure to minimize the effects of anthropogenic habitat disturbance on mussels is short-distance relocations of individuals. However, quantified survival data are lacking to gauge the success of relocations. To evaluate short-distance relocation as a conservation tool for freshwater mussels, we experimentally relocated 2 common species: Mucket and Plain Pocketbook, in an active construction zone. We marked 100 mussels with passive integrated transponders (PITs), released them ~200 m upstream of the construction site, and monitored them monthly throughout the spring and summer of 2013–2015. We used Cormack-Jolly-Seber models to estimate apparent survival rates and found apparent survival was lowest during the first 2 months after relocation but increased and stabilized thereafter. Our models predicted 93% of the relocated Muckets and 71% of the Plain Pocketbooks remained alive 3 years post-relocation. We conclude short-distance relocations are a viable minimization tool for protecting freshwater mussels at bridge construction sites, but further study is needed to examine the factors driving the initial mortality (Tiemann et al., 2016).

Kishwaukee River Mussel Population Study

In August 2015, we initiated an ongoing capture-mark-recapture mussel population study emphasizing rare and state-listed mussels in the Kishwaukee River at I-90, after the lane expansion project had concluded. Each August, a team of researchers from INHS, IDNR, local land management agencies, and other volunteers intensively sample mussels at this site over 2–3 days. We've recorded growth, survival, juvenile recruitment, and movement into/out of the study area for every species encountered to understand biotic and abiotic factors influencing the mussel community. We incorporated a movement analysis of PIT-tagged individuals from the population study (i.e., listed or rare species, original 2013 translocated individuals).

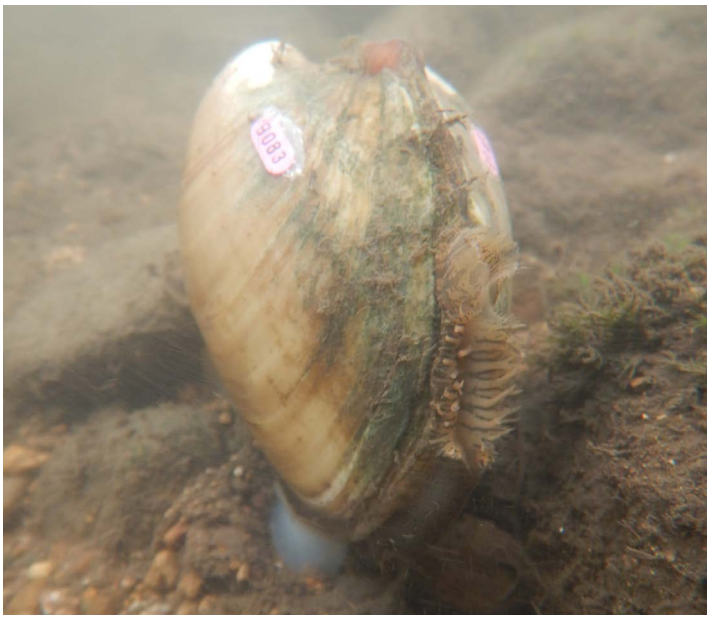
In 5 years, we have encountered approximately 2,489 live individuals of 20 mussel species. We spent 212.5 person-hours sampling with an average of 12 mussels collected per hour. Across the study area, species diversity and evenness has remained similar among years. The east channel was most impacted during the I-90 construction in 2013 because a cofferdam was placed on site. Moreover, a drought in 2012 saw hundreds of individuals relocated from dewatered areas throughout the same reach, and thus, we evaluated recolonization. Since 2015, species richness, composition, relative abundance, and catch-per-unit-effort have declined in the east channel at the impact zone but remained steady or increased in the west channel.



The east channel habitat has changed over the last few years as the river equilibrates from the cofferdam removal and natural processes, most recently with a scour pool adjacent to the pylon and large woody (= tree) debris residing under the bridge. The east side has more in-stream riprap, swifter current, and directly downstream of the bridge resides another pool, a large gravel bar, and a swift channel with high cut banks. These habitat changes make it harder to sample and lessen the suitable habitat for mussels. The west channel's substrates have settled into primarily gravel and sand and appear stable, providing available and suitable mussel habitat, and therefore we are capturing increasingly more individuals in this reach.

For the movement analysis, we have monitored 383 PIT-tagged individuals of 6 species, including individuals from the 2013 translocation study and the current study, over 5 years. We calculated movement by measuring distance and direction between successive mussel locations captured from monitoring events during 2015–2018. Our analyses' significant results include mussels moved greater distances during high discharge and gage height, and downstream movements were greater than upstream. Muckets (common), Plain Pocketbooks (common), and Fluted Shells (rare) were more likely to move downstream with higher discharge, whereas Elktoes (rare) and Black Sandshells (rare) were not. Thus, some species may move more than others or perhaps are more susceptible to displacement during high flows depending on position or placement within the stream.

Lastly, we evaluated directionality in all movements detected in consecutive survey periods. We found mussels exhibited unidirectional movement downstream each winter. Unidirectionality was also found in September to October movement paths, but the direction was perpendicular to streamflow in 2016 and upstream in 2017. Our preliminary movement findings encouraged different relocation practices within the state, for example, by relocating mussels downstream in suitable habitat instead of upstream of the construction activity. Other implications for relocating mussels may include allowing enough time for mussels to establish in a relocation site before fall months and high flow events, evaluating the proximity of a relocation site to the impact area, and the timing and length of construction activity.



Plain Pocketbook Mussel

The annual survey event has provided an opportunity for IDNR, Tollway, USFWS, local forest preserves and conservation district staff, and high school students to gain hands-on experience in study design, sampling, monitoring, and identification of freshwater mussels. Over 5 years, we have hosted staff from the Tollway, IDNR, USFWS, and local municipalities as well as local volunteers, various watershed groups, and 1 class from Sycamore High School. We planned to conduct another year (August 2020) of the current sampling protocol and study design to have 5 years of recapture data (6 years total for the capture-mark-recapture study). However, due to the COVID-19 global pandemic, we could not safely conduct intensive surveys. In 2020, we monitored PIT-tagged animals and conducted targeted survey efforts for tagged animals out of (and some within) the study area (INHS 2017:11; INHS 2018:19; INHS 2019:19).

Associated Research

Elfin Skimmer

Dragonflies

The Odonata (dragonflies and damselflies) are focal species within the Wetlands Campaign of the Illinois Wildlife Action Plan. Two species of concern occur within the greater Tollway region: the Illinois state-threatened Elfin Skimmer and the federally endangered Hine's Emerald Dragonfly (HED).

The Elfin Skimmer is the smallest dragonfly in North America, at less than 2.5 cm in length, and little is known about its life history. Typically found in calcareous fens, we are re-surveying historical locations to determine current distribution, vital information for conservation. We are also conducting additional surveys in nearby suitable habitat to hopefully increase the number of EOR localities for the species.

HEDs are the only federally endangered dragonfly in the contiguous U.S and inhabit fens only in Illinois, Michigan, Wisconsin, and Missouri. We are developing a species distribution model using characteristics (e.g., soils, climate, geology) of known localities to predict potential unknown sites or habitats. We are also building a detection model for the HED to inform land managers and biologists on the effort and ideal environmental conditions needed to confidently determine HED presence at a given location. Repeated random-length timed visual encounter surveys are conducted at fixed locations at a site known to contain HEDs. Environmental variables are taken at the start and end of each survey and will enable us to determine the best conditions to survey for HED (ME20-01).

Aquatic Insects in Bioassessment

Macroinvertebrates are the most common and widely used group of freshwater organisms to assess stream environments, in part because they exhibit a wide range of tolerance to point and nonpoint source pollution. Rapid bioassessment innovation successfully leveraged the ecological and evolutionary conservatism of freshwater macroinvertebrate taxa. Now standardized sampling methodology, deployed with coarse taxonomic precision, is based on the regulatory schemes implementing the Clean Water Act (CWA) in the USA and programs worldwide. Immature forms of aquatic insects can be challenging to identify to species; thus, many protocols do not require species-level information. Furthermore, in the interest of relatively rapid assessment, bioassessment protocols require 1 sampling event and are not intended to be a complete taxa inventory at a site. Other approaches may be more effective for capturing species-level information and species of conservation concern.

In 2019, we sampled multiple streams in McHenry and Lake counties using the ILEPA bioassessment protocol (macroinvertebrate index of biotic integrity or mIBI). We paired adult aquatic insect sampling (light trapping, collecting by hand) at all mIBI sites to identify the degree to which these methods are congruent in species collected.

Wetland Macroinvertebrate Communities in Created Habitats of Northern IL.

Aquatic macroinvertebrate colonization of newly created freshwater ponds is influenced by the dispersal and habitat connectivity. Once organisms arrive at new habitats, local environmental factors (e.g., hydroperiod) and biotic interactions (e.g., vertebrate predators) influence the colonization's success. In 2017, we sampled aquatic macroinvertebrate communities at newly created and historic ponds at Pine Dunes and Orland Grasslands mitigation sites. Post-mitigation sampling took place a year after wetland creation, and we identified over 80 taxa across phyla Annelida, Arthropoda, and Mollusca. We found 4 species of semi-aquatic Hemiptera not previously documented from Illinois (see submitted publications). We are comparing communities in new ponds to those in nearby historic ponds and taxa in all habitats to regional species pools derived from available records and collection information. We will continue to monitor the colonization of these sites over time.

Gravel Chub

Gravel Chub were historically sparsely distributed throughout Illinois, with most contemporary records occurring in the Rock and Wabash River basins. Collection of Gravel Chub at the Jane Addams Memorial Tollway in 2012, before bridge replacement at the I-90 bridge site over the Kishwaukee River, represents their furthest up-stream collection in the Kishwaukee River.

Gravel Chub are typically found in medium to large rivers in reaches with swift, deep waters and sand/gravel/rock substrates. Typical fisheries collection techniques (boat electrofishing) struggle to observe a smaller, benthic oriented fish like the Gravel Chub. Because these techniques are the most widely used during fish community surveys in rivers where Gravel Chub can be found, we likely fail to detect Gravel Chub and have a biased understanding of its abundances and state-wide distribution.

Conservation initiatives regarding the Gravel Chub are hindered due to a lack of life and natural history data. Informative life and natural history studies require large numbers of individuals to be sacrificed. In locations where Gravel Chub populations could withstand the loss, they are not of conservation concern and thus are not researched. In other locations, they are protected, and populations could be severely affected by sacrificing even a marginal number of individuals. Our research is intended to fill data gaps leading to a better understanding of the Gravel Chub in Illinois. Using museum specimens, we measured the number of eggs (fecundity) a typical female Gravel Chub develops (Stites et al., 2018). Such reproductive data are important in determining how drastic the loss of a few individuals can be on the population. In 2019, with funding from the IDNR, we began to intensively sample for Gravel Chub in the Rock River using a modified bottom trawl. Our method is more reliable than most other methods in collecting Gravel Chub from non-wadeable rivers and should help us understand Illinois' Gravel Chub population. In conjunction with our trawl samples, we measure a suite of habitat variables to provide specific habitat details on locations where Gravel Chub occur. Upon completion of the project, we hope to be able to provide improved Gravel Chub conservation recommendations.

Gravel Chub

Iowa Darter habitat

Iowa Darters

During pre-and post-construction monitoring of fish communities along the Jane Addams Memorial Tollway (I-90), we encountered numerous Iowa Darter populations in small streams affected by the construction. Our continued discovery of Iowa Darters from streams along the corridor were surprising because of previous assumptions about the Iowa Darter's habitat use. Due to our consistent observations of robust Iowa Darter populations in small streams, we decided to determine the accuracy of previously published accounts of Iowa Darter habitat in Illinois. Our goals were to determine critical habitat areas for Iowa Darter conservation and estimate the historical and current distribution of Iowa Darters in Illinois. Using historical collections records from across midwestern and Great Lakes states, we developed a species distribution model (SDM) to estimate where Iowa Darters historically occurred in Illinois. Next, we created an SDM with contemporary collections records from Illinois to locate other, potentially unknown, Iowa Darter populations in the state.

In the summer of 2016, we repeatedly sampled 30 sites our contemporary SDM determined to be potential Iowa Darter habitat. In our 2016 sampling, we found 9 new Iowa Darter locations. By combining the new locations with other known Iowa Darter locations and confirmed absence sites from our samples, we produced an SDM better predicting the current range of Iowa Darters in Illinois. When our updated, contemporary SDM of the Iowa Darter's range in Illinois was compared to our historical model, it appeared the Iowa Darter did not have as extensive of a range reduction as previously thought. In the spring of 2019, we presented our results to the Illinois Endangered Species Protection Board. After viewing our presentation the Board voted to downgrade the Iowa Darters in Illinois from threatened to SGCN. Additionally, due to the novel approach we took in creating our SDMs, our study's results were published in the Journal of Fish Biology (Sherwood et al., 2018).

Associated Research

Banded Killifish

While investigating the status of endangered and threatened fishes in the Chicago region, Phil Willink (formerly Shedd Aquarium, now Field Museum) began investigating the Banded Killifish population expansion in Lake Michigan and the Chicago Area Waterways System (CAWS). Banded Killifish populations in Illinois had diminished to just a few relicts in the glacial lakes of Lake County before 2000 (Willink et al., 2019). There are 2 recognized subspecies of Banded Killifish. The eastern subspecies occurs along the Atlantic coastal states down the St. Lawrence River to Lake Ontario, and the western subspecies occurs in the Great Lakes and midwestern states. During his investigation, Dr. Willink reached out to our fisheries staff for assistance on the project. The initial results suggested the new populations of Banded Killifish in Lake Michigan and the CAWS are composed of the eastern subspecies not native to the region (Willink et al., 2018). Dr. Willink and our staff presented these results to the Illinois Endangered Species Protection Board to clarify whether the eastern subspecies' populations are protected under the Illinois Endangered Species Protection Act. Preliminary actions suggest that protected status is not extended to Banded Killifish populations determined to be the eastern subspecies.

At this time, the extent of each subspecies' occurrence is not well established, and the most reliable method for distinguishing between them is through DNA sequencing. To gain further information on this pressing issue, the IDNR has provided our staff, Dr. Willink, and UIUC collaborators with additional funding to provide data. Our goals are to use genetic sequences to delineate Banded Killifish populations requiring protection under the Illinois Endangered Species Protection Act and to attempt to identify morphological features to be used for field identification. Initial results have only located the western subspecies within the inland waters of Lake County and McHenry County in Illinois. Additionally, the Banded Killifish is a target species for eDNA detection within our group, and those methods may allow for more rapid species delineations.

Banded Killifish

Blanding's Turtle hatchling

Blanding's Turtles

The Blanding's Turtle is a state-endangered species and a Focal Species for the Wetlands Campaign of the Illinois Wildlife Action Plan. Once common throughout the Chicagoland area, populations are declining due to habitat loss and fragmentation, and road mortality. We have conducted region-wide status assessments of historical EOR records to aid managers in maximizing species recovery investments. Studies of Blanding's Turtles in the Des Plaines Valley began in 1988, and we continue to monitor these populations. We have examined their spatial ecology, community relationships, genetics, and demographics.

Population declines have been widespread across the Blanding's Turtle's range in Illinois, especially in the greater Chicago Region. With the high number of EORs concentrated in the region, it often becomes logistically and economically difficult to rapidly assess each population's status. Thus, we are developing and testing a detection probability model to enable land managers and other surveyors to determine if they have put in adequate effort to know if Blanding's Turtles are absent at a given site. We are also assessing the current status of the Blanding's Turtle population at Goose Lake Prairie State Natural Area. Finally, we will deploy the detection model and update the occupancy status for the numerous historical locations within the greater Tollway region.

Assessing conservation actions is also a vital step toward recovering declining species. Once threats are identified, conservation actions can be enacted and then monitored in an adaptive framework. Blanding's Turtle eggs and juveniles are vulnerable to predation, so head-starting programs have been initiated in DuPage and Lake counties. DuPage County has released over 2,000 hatchlings and head-started Blanding's Turtles since 1997. We have monitored the DuPage County population and found that releasing 1-year-old turtles is the most efficient strategy for conserving the population. The population has a high proportion of juveniles, but numerous head-started turtles have reached reproductive size (INHS 2020:1; INHS 2019:14; INHS 2018:16).

Gate in concrete Asian Carp Barrier

Asian Carp Barrier

Asian Carp are a group of exotic invasive species stocked originally in farm ponds. After escapes and accidental releases into streams, these fast-growing, prolific breeders have made their way up the Mississippi River and into the Illinois River drainage, devastating biotic communities. As they advance towards the Great Lakes, they threaten a multi-billion-dollar fishery. Various strategies have been implemented to prevent their spread, including bubble nets and electric aquatic "fences." During high water events, the Des Plaines River can overflow into the Chicago Sanitary and Ship Canal, providing a potential unprotected pathway for Asian Carp to reach Lake Michigan.

In 2010 a 13-mile concrete and steel mesh wall was constructed to prevent the Des Plaines River from spilling into the Chicago Sanitary and Ship Canal during flood events. While the barrier is intended to keep Asian Carp from reaching the canal, it functions as a barrier to animal movements (especially reptiles and amphibians) between the Des Plaines River and adjacent wetlands. The USCOE installed 20 gates in the barrier, affording animals passage when there is no threat of flooding. We conducted visual surveys for reptiles and amphibians along the Asian Carp Barrier and attached cameras to 14 gates to determine if animals used them.

Wildlife camera attached over gate in Asian Carp Barrier

Overall, cameras captured 27,284 independent photos of vertebrate animals representing at least 63 species. Although there was a high prevalence of mesopredators, including Raccoons, Virginia Opossums, and Striped Skunks, the cameras captured 5 anuran, 1 salamander, 6 snake, and 5 turtle species: Painted Turtles, Snapping Turtles, Blanding's Turtles, Northern Map Turtles, and Sliders. During paired visual surveys for amphibians and reptiles, we found 37 anurans (5 species), 206 snakes (6 species), and 60 turtles (5 species) along Centennial Trail.

Blanding's Turtle passing through open gate

Turtle blocked by mesh Asian Carp Barrier

There were 12 independent photo captures of Blanding's Turtles, and we found 3 individuals during visual searches along northeastern sections of the barrier. Many depredated nests (54) were found along the trail and barrier and there was evidence of mortality from cycling and mowing. Although the gates effectively facilitated animal movements, the barrier increased predation and mortality risks. Reptiles, especially snakes, were more at risk to bicycle traffic and mowing than predation. We recommended mowing be avoided in late May – June when snake and turtle activity are highest. We also recommended the construction of 3 additional gates between the northeastern most gate and the I-355 Bridge, where numerous turtles were found along the barrier (INHS 2020:3; INHS 2017:15).

Associated Research

Wetland Birds

Marsh birds are undergoing rapid declines in the United States, with habitat degradation and wetland loss considered primary causes. Due to the cryptic nature of many wetland bird species, the factors and scales affecting their occupancy and habitat use remain unclear (Brazner et al., 2007; Glisson et al., 2015). Despite multiple challenges facing marsh birds, according to Breeding Bird Atlases, northeastern Illinois and northwestern Indiana have remained strongholds for many breeding marsh birds, including secretive rails, bitterns, and Black-crowned Night Herons (Kleen et al., 2004; Castrale et al., 1998). Many grassland bird populations are thriving and increasing within small, protected grassland patches in the greater Chicago region (Suarez et al., 2018). Likewise, it is possible that marsh birds thriving in similarly-sized habitat patches have previously gone unnoticed. Our project assesses the impact of wetland, urban, and invasive species-dominated landcover types at multiple spatial scales on marsh bird occupancy to understand their relative impacts on marsh birds in the Chicago area. We evaluate which marsh bird species actively use urban habitat, which wetland types are most valuable across our suite of species of concern, and at what scales management may be most effective. Our primary goal is to assess the value of urban wetlands for multiple marsh bird species of concern, including American Bittern, Common Gallinule, Least Bittern, King Rail, Pied-billed Grebe, Sora, and Virginia Rail, to inform land management decisions.

Juvenile Black-crowned Night-Heron

We conducted counts and playback at 346 points across Illinois and Indiana, using the Standardized North American Marsh Bird Monitoring Protocol developed by Conway (2011). Points were located primarily in the Chicagoland region and typically consisted of wetland patches surrounded by an urbanized matrix. We surveyed wetland patches for 17 focal species, including the

Green Heron

American Bittern, Common Gallinule, Least Bittern, King Rail, Pied-billed Grebe, Sora, and Virginia Rail. We extracted remotely sensed wetland habitat, urban development, and invasive species (*Phragmites*) cover data from the National Wetlands Inventory, the Global Urban Footprint database, and USGS. We created single-species occupancy and abundance models for species of interest to determine how wetland birds respond to different wetland habitat types, urbanization, and invasive Phragmites cover at different spatial scales.

Preliminary results using 2 years of point count and playback survey data suggest Swamp Sparrows, Marsh Wrens, Black-crowned Night Herons, Blue-winged Teals, Common Gallinules, and Least Bitterns persist in urbanized wetlands in Illinois and Indiana, whereas American Coot, Pied-billed Grebe, Sora, and Virginia Rail show occupancy declines with increasing urbanization. We did not detect enough Snowy Egrets, Black Terns, or Yellow-crowned Night Herons to parameterize models adequately. Currently, we are adding a third year of data into our analyses.

Blue-winged Teal

Fermilab National Accelerator Laboratory

Fermilab National Accelerator Laboratory and the Illinois Natural History Survey established a bat survey project in 2017 to monitor species occupancy and relative activity patterns to understand better how regionally declining bat populations use the property. To accomplish this task, we used mist netting and acoustic recorders to survey local bat populations. Throughout the 3 years of this project, we have recorded 66,774 acoustic bat passes and identified spatial and seasonal activity patterns. We manually identified 1 Northern Long-eared Bat call, suggesting the species may use the property, particularly in the Long Baseline Neutrino Facility Woods, though likely in low abundance. During mist net surveys, we caught 9 bats, confirming the presence of 3 species, including the Big Brown, Eastern Red, and Hoary Bat. We caught juvenile and lactating bats, suggesting that these species are reproducing locally.

Big Brown Bat

Roost tree

Morton Arboretum

In 2018, the Urban Biotic Assessment Program completed surveys along I-355 as part of pre-construction monitoring for the Illinois Tollway. These surveys resulted in several acoustic detections of the NLEB at sites within The Morton Arboretum (Rahlin et al., 2019). In 2019, the Illinois Bat Conservation Program completed seasonal acoustic surveys and summer mist net surveys to inventory the bat community at The Morton Arboretum. Using mist netting, we confirmed the presence of NLEB and tracked an adult male to roost trees within the arboretum. Acoustic surveys revealed seasonal patterns of activity with numerous *Myotis* detections.

Bat wing

Associated Research

Northern White Cedar

Northern White Cedar is a state-threatened conifer naturally occurring in the northeastern area of the state. It has been cultivated as a landscape tree, but the planted trees tend not to spread into natural areas. During botanical surveys for the Jane Addams Memorial Tollway Rebuilding and Widening Project, we found populations in wetlands at 2 adjacent properties: Trout Park and Chicago Junior School (CJS). The population at Trout Park had 299 trees, 82 of which were dead, whereas the CJS population had 568 trees.

To understand the differences between populations, we compared seeds and soil characteristics. Because the sites are near a heavily used tollway, we hypothesized that salt spray used to deice pavement might impact plant germination and growth. We collected seeds from mature individuals at both sites and the Morton Arboretum (MA), Chicago Botanic Garden (CBG), and Pakulak Seed and Nursery Co. (PSNC). We compared cone biomass, seed set, seed weight, and seed morphology among sites and then conducted germination trials in a growth chamber with water containing varying salt concentrations. We collected soil core samples from Trout Park and CJS in October 2018, and April, August, and October 2019 to assess soil characteristics, including salt concentrations over the year.

Overall, ~ 35% of the PSNC seeds germinated, less than 10% of seeds from MA and CBG germinated, and Trout Park and CJS had < 1% germination rates. Further, as salt concentrations increased, overall germination decreased. Seeds from PSNC and MA had minimal germination at 400 mM and 200 mM, with seeds from CJS not germinating at concentrations of 100 mM. Salt concentrations in Trout Park soil were significantly greater than CJS throughout the year, with a peak at Trout Park in August. Researchers at the Illinois State Geological Survey have detected chloride levels up to 800 ppm at Trout Park, higher than our maximum of 555 ppm. These high salt concentrations could mimic drought conditions and influence the health of plants and their reproductive success. Factors possibly accounting for differences between the Trout Park and CJS populations include trampling of seedlings and saplings by recreational users of the sites, deer herbivory, and survival of seedlings under chronically elevated salt concentrations.

Northern White Cedar

Northern White Cedar cones

Northern White Cedar sapling

Influence of temperature on salt toxicity to selected freshwater species

A recent assessment of surface and groundwater major ion concentrations indicated road salt runoff increases sodium and chloride concentrations in the Chicago, IL, region by as much as 100%. The United States Environmental Protection Agency (USEPA) has set acute and chronic water quality criteria for chloride at 860 and 230 mg/L, respectively, whereas the Illinois Environmental Protection Agency (IEPA) has a single-value standard of 500 mg/L. While most reported median chloride concentrations at various Chicago region monitoring stations still met both the IEPA and USEPA standards, distinct seasonal variability was observed, with peak winter-time concentrations frequently reaching 600–800 mg/L. Water quality criteria/standards are usually developed using toxicity tests conducted at temperatures indicative of spring or summer conditions (20–25° C). If chloride toxicity to freshwater species is lower at winter temperatures, chloride standards may be overprotective when concentrations peak.

Our goal was to compare the acute and chronic sensitivity of freshwater invertebrates to sodium chloride at a warm test temperature (23–25° C) and a colder temperature, 10° C. We conducted 96-hour acute tests measuring lethality and 14- to 28-day chronic tests measuring lethality and growth inhibition with 4 invertebrate species: the Mayfly *Neocloeon triangulifer*, the amphipod *Hyalella azteca,* the Fingernail Clam *Sphaerium simile*, and the Winter Stonefly *Allocapnia sp.* The stonefly was only tested at 10 °C since it would not normally be present in warm water. We conducted additional tests with the mayfly, amphipod, and clam consisting of a 7-day exposure then a return to background sodium chloride concentrations over 7 days. The tests were designed to simulate the pulsed exposure that might occur under snowmelt conditions. To assess the question of whether the colder temperature reduced toxicity or delayed it, we conducted a test with the mayfly that continued past the normal testing duration until an effect level similar to that observed at 25° C was observed. Finally, we conducted acute and chronic tests (1 test still pending) at warm and cold temperatures with a fish, the Fathead Minnow.

The mayfly, amphipod, and clam all had consistent relief (less toxicity) at colder temperatures, although the relief was only observed in the acute tests in the case of the clam. The pulsed exposures reduced observed chronic effects for the amphipod and the clam, but not the mayfly. The stonefly, only tested in cold conditions, was insensitive to acute NaCl exposure, with <10% mortality at up to 5,000 mg Cl-/L after 4 days. However, chronic effect levels were more similar to those of the other 3 invertebrates. For the mayfly, extending exposure at 10° C to triple the duration (42 days) of the chronic test at 25° C (14 days) resulted in an effect level similar to that observed at the higher temperature. The Fathead Minnow was relatively insensitive to NaCl in acute exposures at both warm and cold temperatures, but as with the other species, toxicity was reduced with lower temperatures. A final chronic test with the Fathead Minnow is pending.

Adult Winter Stoneflies

Larval Mayfly

eDNA Research

Populations of wetland and freshwater species are precipitously declining, making the need for rapid detection methods critical. Environmental DNA (eDNA) is growing as such a method and can be beneficial for rare and cryptic species. Previously, monitoring populations required researchers to physically capture the target species, which can be time-intensive and costly.

Recent advances in eDNA methods have allowed for rapid assessments of a species' presence or absence, sometimes yielding higher detection probabilities than conventional sampling while remaining cost-effective and noninvasive. We currently have several eDNA projects in progress, including using eDNA to detect invasive freshwater mussels, Salamander Mussels and their host the Mudpuppy, Dragonflies, glacial lake fishes (e.g., Banded Killifish and Starhead Topminnow), and cryptic wetland birds.

Testing the role of streamflow on eDNA abundance using the invasive Asian Clam

With eDNA as an emerging method for surveilling rare or cryptic organisms, uncertainties remain concerning the physical, chemical, and biological components of eDNA production, transport, and persistence. We examined the effect of streamflow on eDNA copy number to determine whether high flows would mobilize buried eDNA and increase copy number or dilute eDNA and decrease copy number. We examined the effects of streamflow on the eDNA copy number of the invasive Asian Clam using a longitudinal study through an entire year in 2 midwestern streams and a seasonal study (summer, fall) in 8 streams. Our studies allowed us to investigate the effect of streamflow on eDNA while controlling for factors like temperature and seasonal Asian Clam life history (e.g., reproduction). We found that higher stream flows decreased eDNA copy number (e.g., dilution) and produced false negatives or non-detections despite high Asian Clam densities. Our results demonstrate future lotic eDNA studies should seek to sample at low or base flows when feasible, as high flows can dilute eDNA and affect detectability (Curtis et al., 2020).

Dragonflies

One of our earliest eDNA projects developed and tested primers for 4 common dragonfly species to determine species presence in reproductive (aquatic) habitat. We developed primers for Black Saddlebags, Blue Dashers, Widow Skimmers, and Green Darners. The primers amplified DNA of each target species in lab assays. Field testing of water samples collected across 4 sites in the Tollway region detected 1 species (Widow Skimmer) at a single site (Orland Grasslands) on 2 sampling dates. Though the other species were likely present, many factors can influence eDNA detection, including species life history and phenology, environmental variables and conditions, and sampling artifacts (e.g., the volume of water collected). Future work could determine the role each factor plays in eDNA species detection (INHS 2019:13).

A similar eDNA project focused on a state-threatened dragonfly, Elfin Skimmer, the smallest dragonfly in North America. This diminutive species has conservation status in several states across

Blue Dasher

its range. Though widespread in eastern North America, Elfin Skimmers are locally rare, inhabiting relatively rare habitats on the landscape, e.g., bogs, sedge meadows, and calcareous fens. Additionally, both nymph and adult life stages are cryptic, making them difficult to detect using traditional visual surveys. As a potential conservation tool, eDNA sampling could minimize impacts to rare and sensitive habitats and broaden our ability to identify currently unknown populations. We designed eDNA primer-probe combinations to test for detection of Elfin Skimmers in aquatic habitats. Initial testing of a single primer-probe combination showed amplification of the target organism (Elfin Skimmer); however, the primer also amplified DNA of co-occurring non-target species. Systems with high biodiversity and many co-occurring closely-related species present challenges to eDNA approaches. To date, we have found few studies in the literature applying eDNA methods to dragonflies and think the research could provide a valuable assessment tool to the field of dragonfly and insect conservation.

Fishes

The American Brook Lamprey is a state-threatened species found in large clear creeks in northeastern Illinois. The free-swimming adult stage is short, spawning, and dying shortly thereafter. The larval stage can last more than 5 years, during which the larva burrows in sandy, silty substrate with only its head exposed. This life history makes detecting them with traditional survey methods difficult. For this reason, another of our early eDNA projects focused on detecting the American Brook Lamprey. Our lab tests found our primer for the American Brook Lamprey amplified DNA of the correct species (INHS 2019:13). This listed species can now be more easily surveyed by collecting water samples from suitable habitat and analyzing for shed DNA.

We are currently developing and testing primers for amplifying Banded Killifish and Starhead Topminnow eDNA. In Illinois, the Western Banded Killifish is a state-listed species, whereas the Eastern Banded Killifish is a non-native invasive. If our work is successful, the primers will be specific enough to differentiate the Western and Eastern Banded Killifish and potential hybrids. Development of a subspecies-specific primer will allow for eDNA detection in potentially inhabited wetlands and eliminate the sequencing step needed to determine subspecies yielding an in-house and quicker subspecies determination. Once subspecies are determined, we will process water samples from 3 lakes within the Chicago region to see if they are detected.

Several state-endangered and threatened species occur in glacial lakes of northeastern Illinois. These species are often hard to detect by traditional sampling and may be more abundant than currently believed. We are now collecting samples of several difficult to detect species to develop eDNA primers for surveys in northeastern Illinois. If our surveys find these species are more common than currently known, their listing status may be changed, as was done for the Iowa Darter.

Salamander Mussels and Mudpuppies

The Salamander Mussel is state-endangered and has not been collected alive in Illinois in decades. Salamander Mussels were recorded sporadically throughout the state, with recent dead shell records collected in Vermilion County. They are host-specific, and where most freshwater mussels release their glochidia (larval stage) onto fish species, the Salamander Mussel uses the Mudpuppy as a host. Salamander Mussels and Mudpuppies are difficult to detect during conventional timed-search surveys given their rarity, habitat association with large slab or flat rocks, and diminutive size.

Salamander Mussels

Our objective was to use eDNA to detect the Salamander Mussels' presence in historical and likely extant locations in Illinois. We surveyed 12 sites in northern and east-central Illinois with historical or recent shell data and included several known Mudpuppy records from July–September 2019. We received samples from Wisconsin, where wild Salamander Mussel populations are extant, and propagation efforts at the Genoa National Fish Hatchery are occurring. We incorporated water samples collected opportunistically from the East Fork White River in Indiana, where Salamander Mussels populations are extant. We detected the Salamander Mussels' presence in 2 known wild locations in the East Fork White River, Indiana, but no other field samples collected in Illinois or Wisconsin amplified. Water samples from within the rearing tank at Genoa National Fish Hatchery amplified, but not samples from the inflow or outflow pipe.

Preliminary results have shown we can detect both Salamander Mussels and Mudpuppies from water samples and have even successfully detected both species at 1 site. Further work will include expanding our sampling efforts throughout Illinois, including the greater Chicago region and areas within the Tollway network. The Salamander Mussel's active breeding season is late summer/autumn with a late spring release of juveniles. Mudpuppy activity increases during the winter months and subsides during the heat of summer. We are conducting repeated sampling at several sites to determine if seasonality affects Salamander Mussel and Mudpuppy detection.

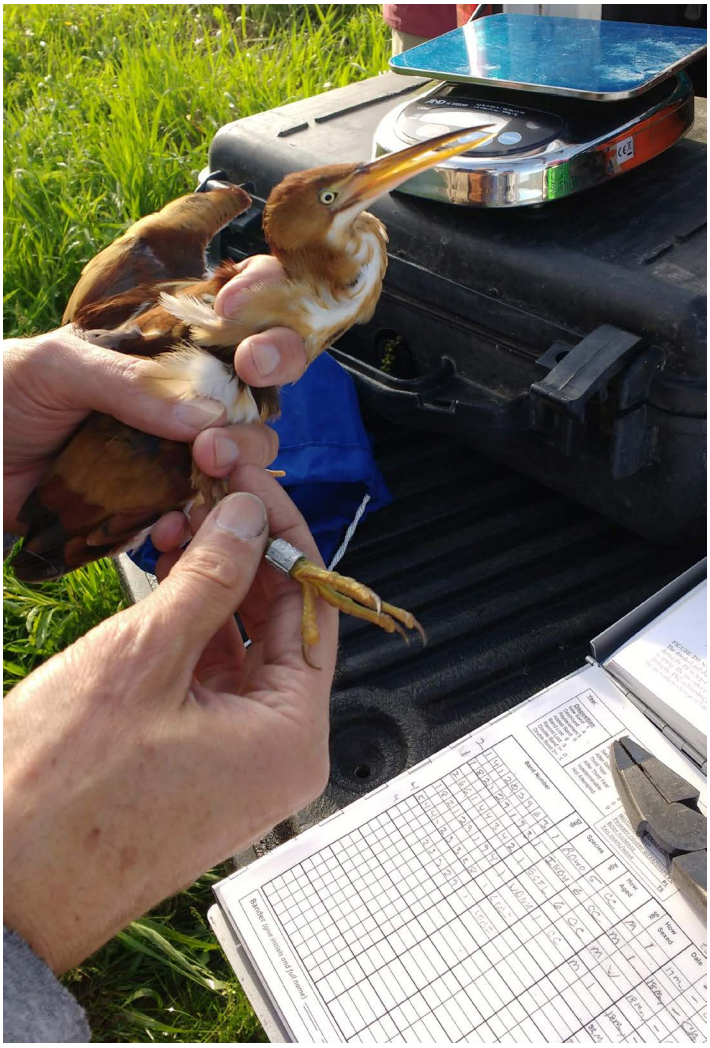
eDNA Research

Birds

With an estimated 5 million acres of wetland habitat lost in the United States since 1950 and widespread wetland bird declines across the Great Lakes region, it is remarkable that wetland fragments in Illinois and Michigan support over 100 bird species. Such species include state-endangered Black-crowned Night Herons, Yellow-crowned Night Herons, American Bitterns, state-threatened Least Bitterns, and multiple cryptic rail species. Population sizes and distributions remain elusive for rails and American and Least Bitterns due to their cryptic natures. Although Black-crowned Night Herons are not cryptic, they are sensitive to human disturbances and may abandon nests if disturbed. We gathered occurrence data on these species of concern using environmental DNA sampling.

Our ongoing research shows we can identify multiple cryptic rail species using degenerate bird and vertebrate primers, meaning identification of bittern and heron species through eDNA sampling appears promising. We expect eDNA sampling to be more sensitive than point count and playback surveys at identifying our species of interest, especially cryptic species like the American Bittern and Least Bittern. We have collected ~500 samples across northern Illinois and Michigan, paired with point count and playback surveys. A portion of Illinois samples have been sequenced, and we have successfully detected rail DNA for multiple cryptic rail species such as Soras, King Rails, and Virginia Rails.

We plan to test whether soil or water samples contain more bird eDNA. We also plan on investigating whether rail, heron, and bittern occupancy increases further from urban centers and with an increased proportion of emergent wetland. The methods we are developing can likely be used in any temperate wetlands to detect cryptic and rare species.



Least Bittern

Sora and Virginia Rail

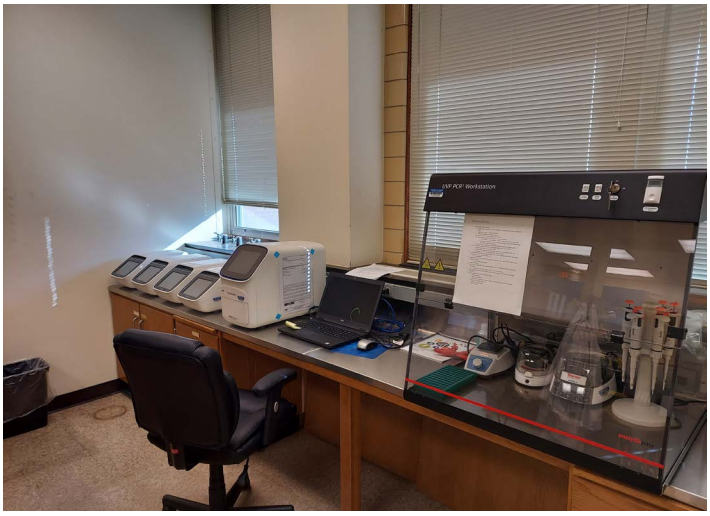
Soil and water samples for eDNA analysis

Future Directions

Currently, eDNA has mostly been used for presence/absence research, but it can be used for population genetics within the right systems. Where traditional techniques for assessing population genetics required the physical capture of large numbers of individuals and collecting genetic samples from them, eDNA can provide a rapid, cost-effective, and non-invasive method of sampling. We will be conducting a mesocosm study looking at the effect of hydroperiod on several salamander species, and by removing water as part of the study, we can test the efficacy of eDNA as a sampling method for population genetic studies using nuclear eDNA. The results could be useful for future population genetic studies of species residing in small ephemeral and semi-ephemeral wetlands, allowing researchers to assess genetic diversity on a broader scale.

Additionally, we have an undergraduate honors student conducting a lab experiment to determine how industrial pesticide/herbicide use can affect eDNA concentrations. eDNA can have a short half-life in the environment, and numerous chemicals and processes can lead to more rapid decay. Using tanks with known densities of Bullfrog tadpoles, we will assess the half-life of shed eDNA from tanks of known tadpole densities over time. Tanks will have tadpoles placed in them for several days allowing them to shed eDNA freely, and then we will remove the tadpoles and treat the water with several concentrations of industrial herbicides and pesticides. The work will better inform eDNA detection studies, particularly those occurring in wetlands and streams that may receive agricultural runoff.

We have also developed a new filtering setup to increase processing efficiency in the lab and field. Each new filtering rig allows us to filter 6 samples simultaneously. Water is collected in the same reservoir and easily discarded after each filtration round without disconnecting vacuum tubes. We currently have 2 rigs, which allow us to filter 12 samples in a fraction of the time needed previously.



Independent Research

Restoration criteria for freshwater SGCN mussels

Mussels are among the most imperiled taxa on earth, with 37 species in Illinois listed as SGCN. Reach-scale restoration efforts are occurring throughout Illinois to improve in-stream habitat. While an ideal situation for re-establishing freshwater mussels would exist in natural recolonization, research indicates that the process is unlikely to occur for critically small populations or may take many years to occur under full habitat connectivity. Our project provided a detailed investigation into restoration options for the Ellipse and Spike, 2 SGCN mussels, using Bayesian Decision Networks (a type of decision-making tool). The project will inform managers of optimal restoration options for a specific scenario; examples of options include stocking host fish, restoring habitat, improving water quality, or augmenting mussels. The project is an initial step to guide state organizations on restoration efforts for mussels in wadeable streams. Investigating restoration criteria and feasibility is necessary to determine the future approach for conserving SGCN mussels and preserving community richness.

Rabbitsfoot Mussel

Rabbitsfoot Mussel

The Rabbitsfoot was listed as federally threatened by the USFWS in 2013 due to significant range contraction and population decline. The USFWS will be initiating a Species Status Assessment (SSA) to help develop a recovery plan and implementation strategy for the Rabbitsfoot. Additionally, one of the IWAP Streams Campaign's goals and actions is "Viable populations of each SGCN will be supported". Rabbitsfoot in the Vermilion River basin (Wabash River basin) is functionally extirpated due to lack of dispersal capabilities beyond Lake Vermilion, an impoundment located on the North Fork Vermilion River. No recent populations of Rabbitsfoot exist downstream of Lake Vermilion on the North Fork or elsewhere in adjacent tributaries or mainstem. In 2018 and 2019, Ellsworth Dam on the North Fork Vermilion River and Danville Dam on the Vermilion River were removed, allowing for contiguous flow from downstream of Lake Vermilion to the Wabash River. In this reach of the North Fork Vermilion and mainstem, current mussel populations were assessed due to the dam removals or other construction activities in the vicinity and are diverse with robust mussel assemblages. Therefore, we propose reintroducing Rabbitsfoots downstream of Lake Vermilion in the North Fork Vermilion River and Vermilion River system. By reintroducing the Rabbitsfoot into its original range within the Vermilion River system, we are supporting federal and state recovery goals.

Furthermore, an evaluation of the current population will provide updated information on the Illinois population for the SSA. The primary objectives will be to evaluate the current population of the Rabbitsfoot in the North Fork Vermilion and Middle Branch North Fork Vermilion rivers for ultimate augmentation within suitable habitat below Lake Vermilion in the Vermilion River watershed.

Asian Clams

Basket Clams consist of moderately-sized freshwater organisms native to the temperate/tropical regions of Asia, Africa, and Australia and contain some of the most common and successful aquatic invasive species. Previously, only the Asian Clam was common in Illinois and found statewide, but a second invader was discovered in 2008 (Corbicula cf. largillierti). The INHS discovered the putatively new basket clam (Form D) to North America in the Illinois River near Marseilles, Illinois, in 2015. Preliminary morphological and molecular assessments have supported 3 Basket Clam invaders in Illinois (Tiemann et al., 2017). Our project consisted of a 2-part (field and lab) study. First, we conducted presence/absence surveys for the novel and recent Corbicula species at several locations across the state to determine the geographic distribution of the three forms. Next, we conducted a robust geometric morphometric assessment on specimens collected. Surveys conducted in 2017 revealed new Form D locations ~40 river miles from the original discovery site, and it's current spread upstream in the Des Plaines River and downstream in the Illinois River. Subsequent genetic and morphometric analyses confirmed the presence of 3 distinct species (Douglass et al., 2020).

Although it has been a dominant member of North American stream communities for 50 years, there is little conclusive evidence about the Basket Clam's effects on native freshwater mussels. Basket Clams can reach high abundance and have the potential to compete with native mussels for food. The Basket Clams' recent arrival in the Kishwaukee River basin in northern Illinois presents a unique opportunity to evaluate its effects on native mussels. One objective is to document the spread of Basket Clams throughout the Kishwaukee River basin. A second objective is to compare juvenile freshwater mussels' growth and survival among sites in the Kishwaukee River basin with a high abundance of Basket Clams and sites lacking Basket Clams. We will place propagated juvenile mussels within silos in streams in the spring and monitor growth rates and survival for approximately 3 months. Results from the study will contribute to our understanding of the effects of invasive Basket Clams on native mussels and the extent to which they factor into native mussel declines.

Chironomid larva

Checklist of Chironomidae

Checklists contribute valuable understanding of distributions of organisms and biodiversity. The non-biting midges, or chironomids (Diptera: Chironomidae), are a specious and important aquatic insect group because they are prey for vertebrates and a key in biological assessments.

We have developed a species checklist of Chironomidae for Illinois with over 175 species known in the state through compilation of historical records, published literature, and original collections from our Tollway work. Including other species known from neighboring states doubles the number of potential species found in Illinois. We continue to add species to our list as we conduct surveys for our Tollway assessments.

Noctuid Moths

Noctuid moths are a cosmopolitan family globally distributed, with ~2,500 species occurring in North America. While caterpillars of some of these species are agricultural pests, noctuid moths perform essential ecosystem functions such as pollination. An ecosystem's health can be directly linked to the species diversity it contains, so we sought to determine the diversity of noctuid moths in several restored sand prairies. Using multiple capture techniques, we identified all species captured to estimate species richness and diversity related to a habitat restoration history. Our results will aid in determining the ecosystem health of newly restored and existing sand prairies.

Osmunda Borer Moth

Rattlesnake-Master Stem Borer Moth

Stem borer moths are declining due to habitat loss, pesticide use, and habitat fragmentation. Of the 35 stem borer species in Illinois, 10 are on the Watch List, 8 are SGCN, 1 is state-threatened, and 1 is potentially extinct. The remaining 15 species have yet to be assessed for conservation status. Once thought to be extinct in Illinois, the Rattlesnake Master (Eryngium) Stem Borer (ESB) was rediscovered in 1989 and subsequently listed as state-endangered. Our project assesses populations and examines the genetic diversity and structure of the ESB across the species' known range, informing management decisions. We assessed ESB populations and their host plant, Rattlesnake Master, at 10 grassland sites in central and southern Illinois and ESB populations in sand prairies of Will County. We conducted larval surveys in July when larvae are actively consuming their host plants. We examined Rattlesnake Master plants for larval damage and extracted the larvae for identification. We also used UV light traps in September to catch flying adult moths. We measured the characteristics of individual plants hosting ESB larvae to determine the ideal host plant size and ESB's potential impact.

Eryngium Stem Borer larva

On a broader scale, we are examining the phylogenetic structure of species within the genus, emphasizing the ESB. Determining the distribution and relationships of stem borer moth species is difficult but important for meaningful conservation measures to be enacted. The project will include previously collected samples of stem borers from Illinois, Missouri, Arkansas, Oklahoma, Kentucky, and North Carolina. Our work will most broadly examine the phylogenetic structure of species within the genus, emphasizing the ESB. We have extracted and amplified DNA from the legs of over 125 individual stem borer moths and are analyzing the genetic sequences we have obtained.

Independent Research

Conserving SGCN Fish

Currently, 80 fish species are listed as SGCN in Illinois. The American Brook Lamprey, Least Brook Lamprey, River Redhorse, Greater Redhorse, Gravel Chub, and Bigeye Chub are focal species of the IDNR Streams Campaign. As taxa-specific experts, our group is creating Species Guidance Documents for these species and identifying knowledge gaps. We are also creating conservation plans for the Greater Redhorse and River Redhorse to maintain and recover these 2 imperiled species. These documents will provide land managers, government agencies, and those in need of incidental take permits the information and resources needed to reduce negative impacts on these species. These documents also provide examples of data deficiencies that might be addressed as mitigation for incidental take.

Bigeye Chub

Conserving Amphibians and Reptiles in Illinois

In Illinois, 25 species of reptiles are listed as SGCN, and as taxonomic experts, we are producing a series of necessary and strategic conservation measures for each SGCN. The process will provide implementable conservation opportunities, prioritize conservation planning efforts, identify important information gaps, and publish this information in Species Guidance Documents and draft conservation plans. Our survey requesting feedback from herpetological experts across Illinois will provide input on threats and needs for all 25 species. The survey has currently been launched, and respondents have until mid-January 2021 to reply. Following the survey, we will be hosting workshops where experts will present known information. We will facilitate discussion between land managers and scientists to determine best practices for herpetological conservation. Finally, our group is currently working on 14 Species Guidance Documents and recovery plans for the Eastern Massasauga and Spotted Turtle for the IDNR.

Silvery Salamander

Blue-spotted/Jefferson Salamander complex

The Blue-spotted/Jefferson Salamander complex comprises the 2 diploid parental species and triploid/tetraploid salamanders with genetic contributions from both parentals. The Jefferson Salamander is a state-threatened species, whereas the polyploid Silvery Salamander is state-endangered. Both "species" breed in small ephemeral/fishless wetlands in east-central Illinois. We are collecting demographic data on abundance, reproduction, growth, and survival to aid conservation planning for the 3 species. One of the Silvery Salamander populations has been found to have a high level of tetraploid individuals, so we are also using genetic analysis to determine the level of hybridization occurring in the population. The data will also help determine salamander land use phenology, enabling land managers to mitigate risk due to management activities.

Bird-Voiced Treefrog

Bird-Voiced Treefrogs

Bird-Voiced Treefrogs are state-threatened habitat specialists requiring high-quality Bald Cypress-Tupelo swamps with appropriate hydrological function. These treefrogs are sensitive to habitat disturbances and are largely intolerant of impoundments that permanently flood their habitat. As such, they may serve as indicators of excessive flooding (or the periodic need for lower water levels). In addition to monitoring hydrological conditions at bottomland swamps across southern Illinois, we've developed a standardized sampling protocol for monitoring Bird-Voiced Treefrogs. We are using this protocol to conduct capture-mark-recapture studies at 10 cypress-tupelo swamp sites in southern Illinois over 3 years. Our study will provide information on abundance, demographics, growth, and survival vital to this species' conservation.

Alligator Snapping Turtles

Alligator Snapping Turtles are the largest freshwater turtle in North America. This sit-and-wait predator was historically reported from the Mississippi, lower Illinois, Ohio, and Wabash rivers and their tributaries, with the most recent observation in 1984 in Union County. Believed to be extirpated from Illinois and other areas, a multi-state reintroduction project was initiated in 2014 by the IDNR in collaboration with officials in Louisiana and Oklahoma. Because mortality is high in the first few years of life, turtles are head-started in captivity at Tishomingo National Fish Hatchery. Some individuals released in Illinois were reared at the Peoria Zoo and by classrooms across Illinois. Across all 3 states, 548 head-started Alligator Snapping Turtles were released during 2014–2016. We attached radio-transmitters to 134 turtles in Illinois over those first 3 years. Survival results were complicated due to radio-transmitter malfunctions; however, overall survival was low. Turtles in Illinois grew slower than those in Oklahoma and Louisiana, and predation by raccoons was high. While assessing the survival of reintroduced turtles in fall 2014, a wild turtle, estimated to be at least 18 years old, was found, the first in the state in 30 years.

Juvenile Alligator Snapping Turtles with radio transmitter

Because ASTs are sit-and-wait predators, they are difficult to detect using traditional methods, and their presence may be more effectively detected using eDNA. We collected water samples at the site where we reintroduced ASTs to test how different environmental conditions impact our ability to detect AST eDNA. We found that percent canopy cover was correlated with eDNA sampling performance, attributed to solar degradation of DNA. The method may also be used to determine the biomass of the species upstream of the collection site. We used eDNA techniques paired with traditional hoop nets to survey a potential reintroduction site in Indiana. We trapped 469 turtles of 8 species over 340 trap nights. Even though no AST were captured, we detected AST in our eDNA samples, indicating more intensive trapping is needed (INHS 2018:35).

Paired hoop-trap and eDNA sampling for AST

Ornate Box Turtles

Ornate Box Turtles are protected in 6 states in the Midwest, including Illinois, where they are listed as threatened and may occur in large numbers at only a few protected prairie sites. Before implementing a conservation plan for Ornate Box Turtles, it is imperative to generate baseline demographic data, determine viability, and identify additional threats to the populations. We are monitoring populations across their Illinois range to gather this data. While the habitat necessary for these turtles requires prescribed fires and the removal of woody species, such activities can also negatively impact the turtles. Turtles cannot easily escape a fire or earth moving equipment; thus, land managers must time management activities when turtles are at least risk of mortality. We are monitoring emergence and ingress from hibernation sites, where turtles are more protected, to inform the timing of these activities.

Ornate Box Turtle

Independent Research

Eastern Massasauga

Eastern Massasauga

The Eastern Massasauga is currently listed as a federally threatened species under the Endangered Species Act and is a state-endangered species in Illinois (Herkert, 1994; USFWS, 2016). Over 50% of historical populations have been lost across its range, with the Eastern Massasauga now only persisting in small geographically isolated populations, with only 1 regional population thought to be secure. The cause of the decline is primarily due to loss of critical habitat and unwarranted persecution by humans. Previously Eastern Massasaugas could be found throughout the northern 4/5 of Illinois, including in the Tollway network, but now the last remaining breeding population exists in small disjunct habitat patches around the southern periphery of Carlyle Lake. Monitoring of the Eastern Massasauga at Carlyle Lake started in 1999 and continues to the present. In subsequent years we plan to determine the likelihood that Eastern Massasaugas are extirpated from historic sites by resampling those sites and inputting collected data into a species-specific occupancy tool. With the continued long-term monitoring, we will provide more detailed and quantitative assessments of viability, extinction risk, and threats to the species. Such work is imperative, given only 1 known cluster of Eastern Massasauga populations remains on Illinois's landscape, and the demographic information collected can be used in range-wide conservation and management guidance.

Visual encounter surveys for Eastern Massasauga

Snake Fungal Disease

Emerging fungal pathogens are becoming increasingly relevant to the conservation of wildlife populations. Widespread die-offs from pathogens such as White-nose Syndrome in bats and chytrid fungus/B. sal in amphibians have been implicated in population declines and pose a severe threat to many species. Ophidiomycosis, also known as snake fungal disease (SFD), is an emerging fungal pathogen in North America caused by the fungus Ophidiomyces ophiodiicola. The fungus, which can persist in soil and grows at a wide range of temperatures, is keratinophilic. It causes skin lesions ranging from minor scale abnormalities to severe swelling, disfiguration, tissue/bone loss, and death. While the primary mode of transmission is unknown, an infection can likely occur through contact with the soil (especially if there are abrasions on the skin), contact with other infected individuals, or passed from mother to offspring in livebearers. In the case of pit-vipers, the nasolabial pit is also a likely entry point. We began our research on SFD in 2008 when we encountered 3 Eastern Massasauga Rattlesnakes (EMR) at our long-term study site with lesions on their heads. Necropsies revealed the fungal infection had not been seen in wild populations but was known in the captive reptile community.

Eastern Massasauga with lesions caused by Ophidiomycosis

By 2017, researchers across the eastern United States documented SFD in 22 states in more than 15 genera of captive and free-ranging snakes. No targeted sampling had been conducted in Indiana, despite the confirmed occurrence of SFD in all bordering states. Many of the genera reported susceptible to SFD occur within Indiana, leaving a gap in our understanding this pathogen for subsequent conservation plans. Contracted by Indiana DNR, we documented the occurrence and prevalence of SFD in free-ranging snakes throughout Indiana. Ophidiomyces was detected in 12 of the 25 species tested (and 2 unknown species samples). Common Watersnakes made up most of Ophidiomyces positive individuals, but Kirtland's Snakes, Black Racers, Eastern Milksnakes, Bull Snakes, Queensnakes, and Red-Bellied Snakes were also infected.

Kirtland's Snake

Kirtland's Snakes inhabit wet prairies where they spend most of their lives underground in crayfish burrows. The conversion of wet prairie habitat to support urbanization and agriculture has resulted in the Kirtland's Snake being listed as threatened in Illinois. The USFWS also reviewed Kirtland's Snake for federal listing, but ultimately no listing decision was made because data were too sparse for an assessment. We are conducting capture-mark-recapture studies on 3 Kirtland's Snake populations to provide information on abundance, demographics, growth, and survival and to close the knowledge gap. Additionally, we are developing a species distribution model to identify areas with potentially suitable habitat and conducting surveys at historical sites to estimate detection and occupancy rates. Our research enables us to assess the status and distribution of Kirtland's Snake and inform future conservation decisions.

Radio telemetry of Timber Rattlesnakes

Timber Rattlesnake

Timber Rattlesnakes den communally in rocky outcrops and crevices throughout most of their range, with gravid females often gestating near denning sites. Snakes exhibit high fidelity to their denning locations, returning to the same sites throughout their lifetime. To more accurately determine Timber Rattlesnakes' status and distribution in Illinois, we must identify and survey potential den sites throughout the species' range, from Mississippi Palisades State Park in northwestern Illinois to the Trail of Tears State Forest in the southern tip of Illinois. In addition to collecting basic demographic information, we monitor emergence and ingress at hibernation sites, which will help inform the timing of management activities.

Kirtland's Snake

Chicago River Restoration Potential

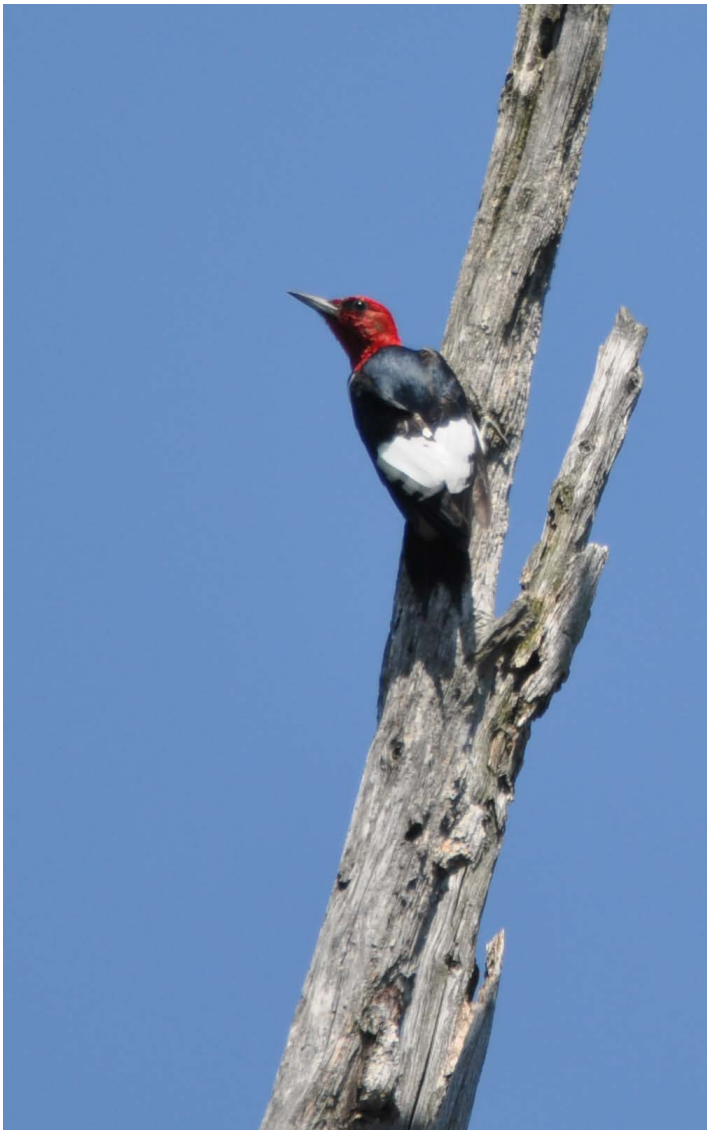
Within the Chicago region there is potential for wetland restoration activities benefitting turtle species. To maximize restoration efficacy, we were tasked with assessing 18 sites for their potential to be restored to benefit freshwater turtles and identify targeted conservation opportunities. We ground-truthed conditions of 10 of the sites: Skokie Lagoons, Sag Quarries, Beaubien Woods, Sweet Woods, Jurgenson Woods, McClaughry Springs Woods, Wampum Lake, Watersmeet Woods, Chipilly Woods, and Leahy Park and provided recommendations to maximize restoration impact. Skokie Lagoons, Sag Quarries, and Beaubien Woods had the highest potential for restoration to benefit turtle populations. Some of the most effective actions include improving nesting habitat, controlling mesopredators, and removing exotic invasive plant species. Restoration efforts at Chipilly Woods and Leahy Park would likely not benefit turtle communities but may benefit other aquatic organisms. The remaining sites would have limited potential to benefit diverse turtle communities.

Timber Rattlesnake

Independent Research

Red-headed Woodpecker

Red-headed Woodpeckers, an SGCN, are declining in the northern portion of their range, but much remains unknown about their ecology. Like all woodpeckers, they are cavity-nesters and likely face intense competition for available habitat during the breeding season. Although characterized as a savannah species, comparisons of nesting attempts by Red-headed Woodpeckers between open savannah and closed-canopy forests have been rarely investigated. Red-headed Woodpeckers cache acorns, but the influence of acorn mast seeding has also been poorly studied. Previous research has compared Red-headed Woodpecker population changes to population changes in invasive European Starlings (cavity competitor) and Red-bellied Woodpeckers (cavity and acorn competitors) but did not consider potential impacts of Northern Flickers and Eastern Bluebirds (potential cavity competitors), or Blue Jays (potential acorn competitors). Finally, age structure in breeding success has mostly been ignored.



Red-headed Woodpecker

Red-headed Woodpecker being processed

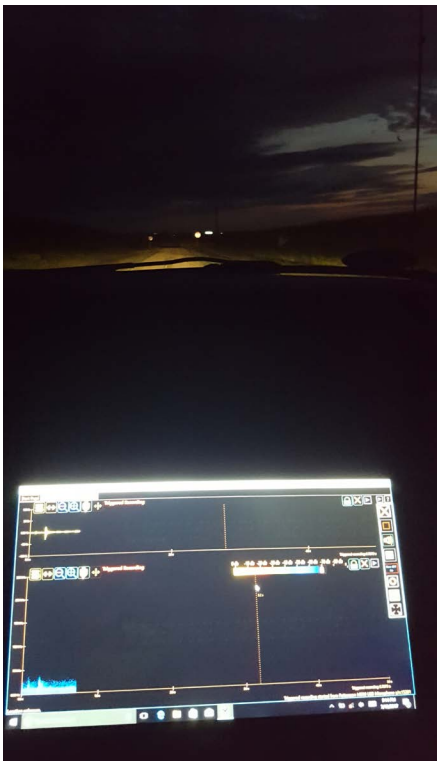
In the spring and summer of 2017, 2018, and 2019, we found Red-headed Woodpeckers breeding in closed-canopy forests and oak savannah patches in northern Illinois. We noted Red-headed Woodpeckers, Red-bellied Woodpeckers, and Northern Flickers responded aggressively to Red-headed Woodpecker call playbacks at some sites, but at others, woodpeckers ignored playbacks. Since aggressive responses in birds have been linked to both increases and decreases in breeding success, we were interested in quantifying aggressive responses between Red-headed Woodpeckers and possible competitors and seeing if responses vary between closed and open-canopy forests. Since woodpeckers can be aged up to 4+ years by the molt limits identified in feather tracts, we are also interested in determining whether woodpecker age influences competition strength. In 2018 and 2019, we collected nest success data from Red-headed Woodpecker pairs breeding in Cook and Lake counties. We captured 6 adults and created a new canopy mist-net rig to increase capture successes (Rahlin et al., 2019). This system will enable us to survey for these SGCN more effectively. Finally, we have been conducting an annual acorn count across forest preserves in northern Illinois since 2018 to determine if breeding success increases during or following high mast years.

Supporting Bat Conservation

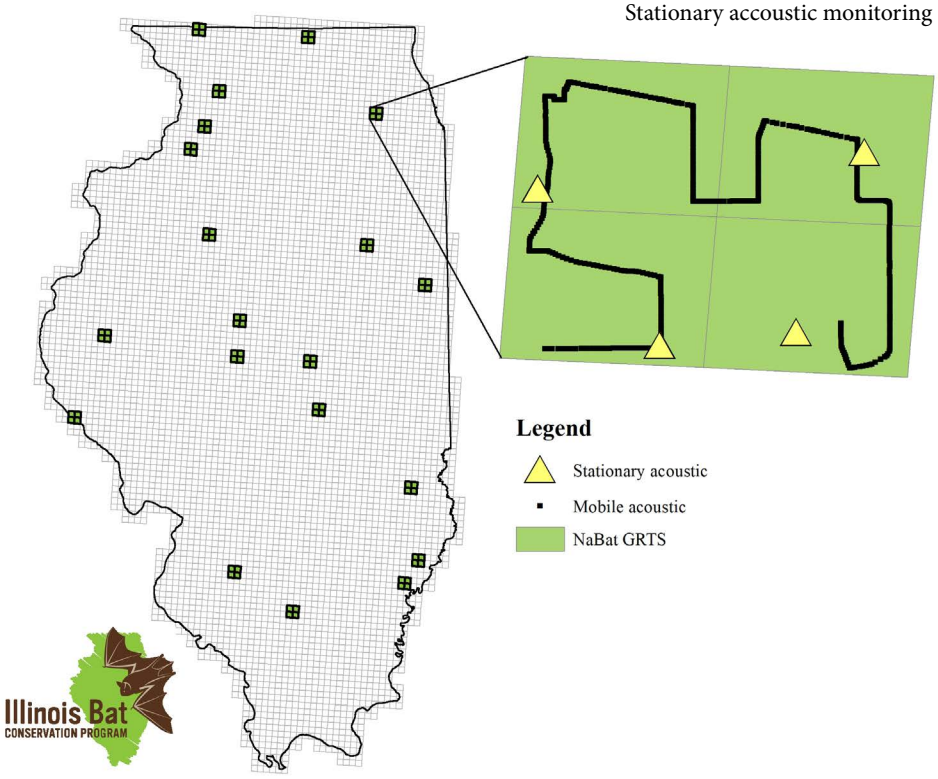
Many bat species are in decline due to various threats, including White-nose Syndrome (WNS), habitat loss and degradation, wind turbines, and insect declines. All 13 bat species in Illinois are insectivores, serving an important role in agricultural pest control. Like birds, bats have species-specific calls that can be recorded with acoustic monitors and analyzed to identify species present in a passive manner. The Illinois Bat Conservation Program (IBCP) in the INHS focuses on the recovery and conservation of Illinois' bat species. Our work within the Tollway network has assisted the program's goals. For example, the IBCP has established the Illinois Bat Acoustic Monitoring Network (iBAM) of stationary acoustic monitoring and weather stations that track bat movements throughout the state and analyze ecological and weather covariates that influence bat movement patterns. Some of these stations occur within the Tollway region and provide data to assess bat activity patterns.

We work with land managers to understand the management techniques employed, the decision-making process managers are using to drive implementation, and determine which practices appear to influence bat occupancy and community composition. Combining this information with our monitoring data, we can inform management decisions to protect these species. We are expanding our citizen science data collection to include equipment that can be checked out for walking transects, training students, staff, and resource managers, and providing education and outreach activities for the general public.

Stationary accoustic monitoring site



Mobile accoustic monitoring



Independent Research

Lake County Ravine Flora Inventory

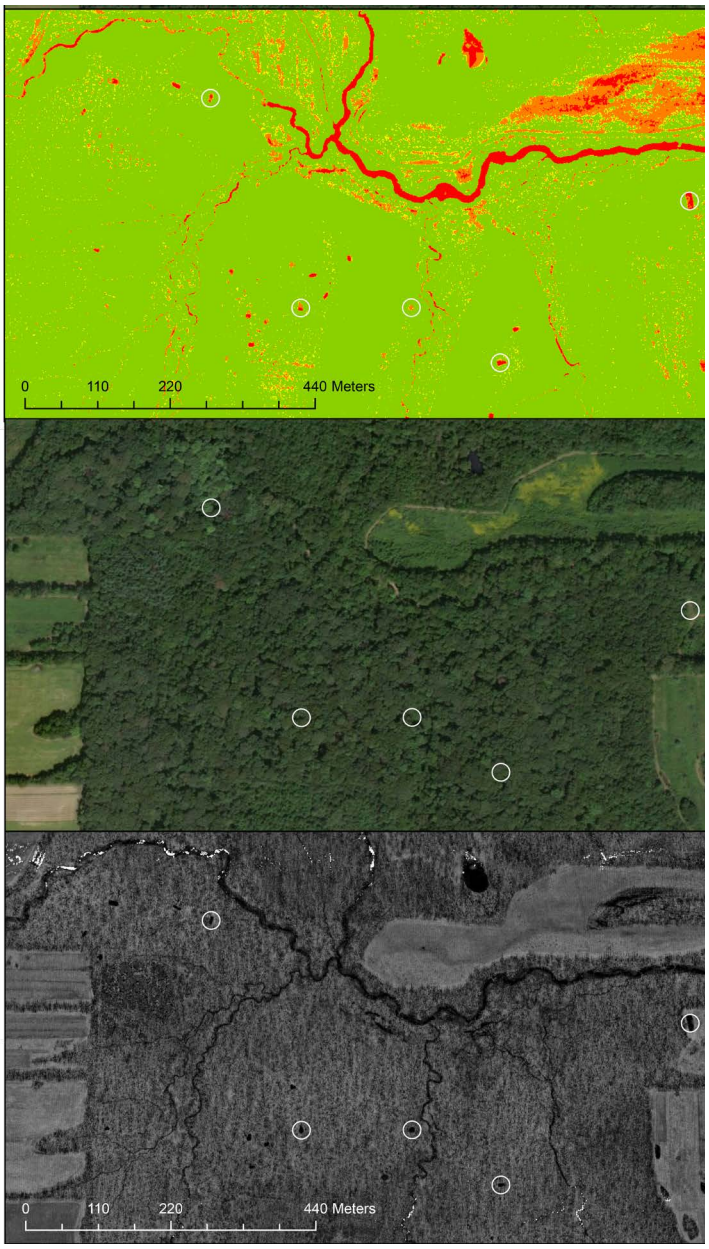
The ravines lining the Lake Michigan shoreline north of Chicago formed when water drained from high moraines following the glacial retreat at the end of the Wisconsin glacial episode. The ravine system is the only natural drainage into Lake Michigan from Illinois. It is a delicate ecosystem providing habitat to many rare plant and animal species and manages water runoff. The North Shore ravines are threatened by erosion and development. We are collaborating with the Lake County Forest Preserve District and fellow INHS botanists to inventory the vegetation in ravines along the Lake Michigan North Shore, in Lake County and northern Cook County. The baseline dataset resulting from our timed meander surveys at 25 sites in spring, summer, and fall will help scientists and land managers understand the impacts of development on these plant communities. The results will help prioritize management in high-quality areas and aid restoration in more degraded ravine communities. Vegetation sampling at the ravines began in spring 2019 and will conclude in fall 2021.

Improving Detection of Cryptic Forested Wetlands with LiDAR Derivatives

Ephemeral wetlands are shallow, depressional wetlands occurring throughout the eastern and midwestern United States. Distribution and abundance of ephemeral wetlands are often regarded as indicators of overall ecosystem health and are especially important to numerous species of plants and wildlife. In addition to their biological importance, ephemeral wetlands play critical roles in hydrology (surface water storage and groundwater exchange), biogeochemical cycling, and energy exchange with adjacent terrestrial habitat (via amphibian and macroinvertebrate production and dispersal). Forested ephemeral wetlands are vital but are often missed by remote sensing techniques used to build the National Wetlands Inventory (NWI). The lack of detection is problematic because forested wetlands are simultaneously the most abundant and one of the most imperiled wetland types in the United States. Differential protection due to detection biases present in NWI data layers creates potential impacts on wetland abundance and diversity. The variable hydroperiod of ephemeral wetlands means they are only seasonally detectable using traditional aerial photointerpretation. Additionally, ephemeral wetlands are often small and not detectable with the resolution of photographs used by the NWI.

Our study's primary purpose is to develop and refine a methodology for detecting and cataloging these ephemeral forested wetlands using Lidar (light detection and ranging). Lidar is a remote sensing technique that provides a highly accurate model of the earth's surface. Where radar uses sound returns to determine an object's distance, lidar uses laser pulses and their return speed to obtain a highly accurate 3-dimensional model of the environment. Thus, the sensor's light can penetrate tree canopies and other vegetation structures that obscure the ground in aerial imagery. This characteristic makes lidar more easily interpretable for elevation mapping and provides a pathway for novel uses in remote sensing. Our initial work will occur in southern Illinois, focusing on ephemeral wetlands within the Shawnee National Forest. The work will consist of ground-truthing known, and Lidar detected wetlands to determine the Lidar model's accuracy.

Once completed, the methodology and process can be expanded wherever Lidar data exist, particularly in the Tollway region.



Depictions of landscape using three methods: Top—Intensity of return; Middle—leaf on aerial image; Bottom—basin detection method

Collaborations

One of our strengths is our strong working relationships with various agencies across the region. Our reputation and long history enable us to efficiently conduct our work and often serve as a bridge for others. Various government agencies and NGOs request our group's knowledge and advice. We serve leadership roles in various partnership programs, on Species Technical Advisory Committees, and working groups.

We research endangered and threatened species within state- and county-managed lands and consult on improving lands to support the maintenance of biodiversity. Because of our reputation, we are often solicited to conduct conservation-related projects through these agencies. Some of the agencies we have long-term relationships with include:

Municipal Agencies

- Boone County Conservation District
- Champaign County Forest Preserves
- Chicago Park District, and local volunteer stewards
- Forest Preserves of Cook County
- Forest Preserve District of DuPage County
- Forest Preserve District of Kane County
- Forest Preserve District of Will County
- Lake County Forest Preserves
- McHenry County Conservation District
- Winnebago County Forest Preserves

State and Federal Agencies

- Illinois Department of Natural Resources
- United States Fish and Wildlife Service
- United States Forest Service
- National Great Rivers Research and Education Center

NGOs

- Audubon Great Lakes
- Chicago Botanic Garden — Plants of Concern
- Chicago Wilderness
- Partners in Amphibian and Reptile Conservation—Midwest

Supporting Collections

Museum collections are an important repository of biodiversity knowledge, often serving as a historical reference. Collections-based research can help determine trends in ecological and species distributional patterns. Our work has added valuable specimens to the biological collections at the INHS. These repositories of specimens date back over 150 years and are a vital tool to understand the change in Illinois' habitats and species composition over time. Over the past 5 years, we have contributed:

- 44 lots to the INHS Fish Collection
- 410 lots of 1,995 specimens to the INHS Mollusk Collection
- >20,000 specimens of aquatic invertebrates collected for water quality determinations are being identified and accessioned

Grants

We have successfully leveraged our contract with the Tollway to secure numerous grants to support conservation research within the Tollway network, Illinois, and the United States. We have received more than $1.75 million over the past 5 years from the USFWS, forest preserve districts, state departments of natural resources, and many other NGOs.

Forest Preserve District of DuPage County

- $36,600 over 3 years for "Demographic Monitoring of Blanding's Turtles (*Emydoidea blandingii*) at Pratt's Wayne Woods Forest Preserve."

Forest Preserve District of Will County

- $29,793 for "Surveys for the Blanding's Turtle (*Emydoidea blandingii*) in the Lower Rock Run Creek Preserve System."
- $19,204 for "Assessment of *Eryngium* Stem Borer Moth status in Will County Sand Preserves."

Illinois Department of Natural Resources

- $19,953 for "Surveys for the Spotted Turtle and Blanding's Turtle in the Des Plaines River Valley."
- $29,717 for "Interpretive signs for the Lake Michigan Beaches." Coastal Management Program.
- $15,600.00 for "Status Assessment of the Gravel Chub (*Erimystax x-punctatus*) in Illinois."
- $12,501 for "Genetic Analysis of the Rapid Expansion of the Banded Killifish (*Fundulus diaphanus*) in Illinois."
- $10,024 for "Population genetics of the rattlesnake-master borer moth (*Papaipema eryngii*)."

Indiana Department of Natural Resources

- $98,351 for "Environmental DNA Surveys for the Alligator Snapping Turtle (*Macrochelys temminckii*) in Southwestern Indiana."
- $114,615 for "Occurrence of Snake Fungal Disease in Indiana." State Wildlife Grant.

Louisiana Department of Wildlife and Fisheries

- $122,191 for "Coordinated Surveys for Alligator Snapping Turtles in Louisiana."

United States Environmental Protection Agency

- $134,324 for "Improving Detection of Cryptic Forested Wetlands with LiDAR Derivatives."

US Fish and Wildlife Service

- $158,049 for "Assessing the Status of Key Blanding's Turtle Populations." State Wildlife Grant.
- $31,177 for "Conservation Genetics of the Eastern Massasaugas (*Sistrurus catenatus*) in Illinois."
- $117,298 for "Demography of 2 Salamander Species in Conservation Need." State Wildlife Grant.
- $179,460 for "Population Demography of Bird-voiced Treefrogs in Southern Illinois." State Wildlife Grant.
- $145,113 for "Long–term Conservation Planning for the Eastern Massasaugas (*Sistrurus catenatus*)." State Wildlife Grant.
- $35,000 for "Patch Occupancy and Host Plant Effects of the *Eryngium* Stem Borer Moth (*Papiapema eryngii*) in a Managed Landscape." State Wildlife Grant.
- $296,064 for "Critical Conservation Issues and Adaptive Management of Imperiled Herpetofauna in Illinois." State Wildlife Grant.
- $310,000 for "Conservation Actions for Dragonfly, Fish, and Reptile Species in Greatest Conservation Need." State Wildlife Grant.
- $300,000 fo Status assessment of odonates in Illinois.
- $59,867 for Supplemental funds: Critical conservation issues and adaptive management of imperiled herpetofauna in Illinois.

NGOs

- $8,000 for "Bat Inventory and Monitoring at The Morton Arboretum" from the Morton Arboretum.
- $24,000 for "Surveying for the Alligator Snapping Turtle in the Patoka and White River Watersheds of Indiana" from The Nature Conservancy.

Shaping the Future

One of the most important things we do is foster a love and understanding of conservation science in the next generation. Whether presenting at public events, collaborating on citizen science projects, teaching workshops, or mentoring undergraduate and graduate students, we understand the value of this endeavor. Many of the over 26 technicians and undergraduate students who have worked for us continue collaborating after their positions end. Through our lab alumni, we have added collaborators at Whitefish Point Bird Observatory, Audubon Great Lakes, University of Iowa, Southern Illinois University, Texas Tech University, Arizona Fish and Game Department, Texas Parks and Wildlife, and McNeese State University, among others. Several individuals have gone on to veterinary school or earn graduate degrees, even within our lab. Tollway support has enabled our group to advise and fund 6 Ph.D. and 8 M.Sc. students through the University of Illinois.

Doctoral Degrees Awarded

- Kelsey Low (2019) Persistence of ranavirus in an east-central Illinois amphibian community – advisor Dr. Christopher A. Phillips
- Ethan Kessler (2020) Assessment of a freshwater turtle reintroduction

Masters Degrees Awarded

- Jason Ross (2016) Spatial ecology of the Smooth Softshell Turtle (*Apalone mutica*) in the Kaskaskia River of Illinois
- Christina Feng (2018) on Demography of the Spotted Turtle (*Clemmys guttata*) in Illinois
- Devin Edmonds (2020) Ornate Box Turtle (*Terrapene ornate*) demography in northern Illinois

Current Ph.D. candidates

- Devin Edmonds – Conservation of Madagascan frogs
- Andrew Jesper – Brumation ecology of the Timber Rattlesnake (*Crotalus horridus*) in Illinois
- Anastasia Rahlin – Conservation of wetland and riparian migratory birds
- Daniel Swanson – Evolution and systematics of annulate New World Harpactorinae – advisor Dr. Sam Heads

Current MS candidates

- Shay Callahan – Phenology and fecundity of state-listed salamander species in Illinois
- Alma Schrage – Detection and foraging needs of declining bumble bee species
- Tyler Stewart – Distribution and detection of Kirtland's Snake
- Grace Wu – The effects of tallgrass prairie restoration on snake communities in northern Illinois
- Sara Johnson – Population and reproductive ecology of a rare Florida mint – advisor Dr. Brenda Molano-Flores

In addition to their own projects, many graduate and undergraduate students take the opportunity to gain experience by assisting other projects in the lab. We've also mentored 3 postdoctoral researchers, enabling them to gain valuable real-world experience in applied ecological research. We've worked with students from Sycamore High School's Environmental Class on watershed projects focusing on freshwater mussels and led Illinois RiverWatch Mussel workshops for municipal agencies.

Our group also operates the INHS Traveling Science Center (TSC), a nature center housed in a 40-foot trailer. Tollway support enables us to apply for funding to staff the TSC to bring natural history and conservation knowledge to Illinois communities. The goal of the TSC is to provide an objective, quality mobile education on natural resources and environmental stewardship to all ages and to foster a connection between families and the natural resources of Illinois. We also promote the research conducted by our group as well as the Prairie Research Institute, the individual state surveys, and the University of Illinois. The TSC's goals are achieved by providing visitors a hands-on experience using a stunning display of interchangeable educational panels, interactive displays, props, and handouts. The numerous venues to which the TSC travels reaches a broad demographic of Illinois' population.

Communicating Science

Every year our group gives talks and programs for various public events such as the Illinois State Fair, Chicago Herpetological Society's Reptilefest, Earth Day celebrations, scouting events, bioblitzes, and conservation days to promote tollway supported research. We are invited to speak to audiences at park districts, forest preserve districts, libraries, and non-government organizations. In the past 5 years, our group has participated in over 50 public events and more than 100 school presentations.

In addition to sharing our science with the general public, we present at societal conferences and publish peer-reviewed papers. We have presented over 120 talks and posters at conferences across the country in the past 5 years. We have published more than 60 peer-reviewed articles and articles for popular consumption.

Conference Presentations

2020

Callahan, S. A., A. R. Kuhns, J. A. Crawford, C. A. Phillips, and M. J. Dreslik. 2020. Phenology of breeding migrations of three *Ambystoma* species. Midwest Fish and Wildlife Conference, Springfield, Illinois.

Douglass, S.A., E.J. Kessler, and M.J. Dreslik. 2020. Freshwater mussel movement in the Kishwaukee River, Rockford, Illinois. Midwest Fish and Wildlife Conference, Springfield, IL. Poster.

Dreslik, M.J., J. P. Wiker, T. L. Esker, and J. M. Mui. 2020. Status of borer moths (*Papaipema*) in Illinois with an emphasis on the Rattlesnake-master Borer. Midwest Fish and Wildlife Conference, Springfield, IL. Poster.

Edmonds, D. A., and M. J. Dreslik. 2020. Ornate Box Turtle (*Terrapene ornata*) demography in Illinois. Midwest Fish and Wildlife Conference, Springfield, IL.

Hohoff, T. C., J.A. Kath, A.B. Cable, and M.A. Davis. 2020. Illinois' Chiropteran landscape: leveraging NaBat acoustic data to inform conservation of Illinois' bat biodiversity. Midwest Fish and Wildlife Conference, Springfield, IL.

Jesper, A. C. B., and M. J. Dreslik. 2020. Over-wintering phenology of the threatened Timber Rattlesnake (*Crotalus horridus*) in Illinois. Midwest Fish and Wildlife Conference, Springfield, IL.

Kessler, E. J., S. Ballard, and M. J. Dreslik. 2020. The Alligator Snapping Turtle (*Macrochelys temminckii*) reintroduction in Illinois: an adaptive approach. Midwest Fish and Wildlife Conference, Springfield, IL.

Kuhns, A. R., J. A. Crawford, C. A. Phillips, M. Corcoran, and M. J. Dreslik. 2020. Herpetofaunal species of greatest conservation need in forested wetlands of southern Illinois. Midwest Fish and Wildlife Conference, Springfield, IL.

LaGrange, S. M., L. Adamowicz, M. C. Allender, S. J. Baker, and M. J. Dreslik. 2020. Long-term monitoring of snake fungal disease in the Eastern Massasauga in Illinois. Midwest Fish and Wildlife Conference, Springfield, IL.

Phillips, C. A., A. R. Kuhns, J. A. Crawford, M. J. Dreslik, and J. Adams. 2020. Surveys for Kirtland's Snakes in Illinois. Midwest Fish and Wildlife Conference, Springfield, IL.

Rahlin, A. 2020. How well does an eDNA metagenomics approach detect cryptic and rare wetland bird species? Environmental DNA Symposium, Midwest Fish and Wildlife conference, Springfield, IL.

Ross, J. P., D. Thompson, and M. J. Dreslik. 2020. Population viability analysis and the role of head-starting for a northern Illinois Blanding's Turtle population. Midwest Fish and Wildlife Conference, Springfield, IL.

Schrage, A. C., J. L. Robinson, and M. J. Dreslik. 2020. Foraging and nesting habitat of a *Bombus* community in a documented *B. affinis* site in northern Illinois. Midwest Fish and Wildlife Conference, Springfield, IL.

2019

Baker, S.J. , L. Adamovicz, M. Merchant, and M. Allender. 2019. Site specific differences in health and immune function of Eastern Box Turtles (*Terrapene carolina carolina*). Turtle Survival Alliance Annual Conference, Tucson, AZ.

Bilger, E.E., J.A. Crawford, and B.H. Ousterhout. 2019. Conservation assessment of Odonata in Illinois. Annual meeting of the Society for Freshwater Science, Salt Lake City, UT, May 19–23, 2019.

Douglass, S.A., J.S. Tiemann, E.J. Kessler, and M.J. Dreslik. 2019. A preliminary analysis of mussel population dynamics in the Kishwaukee River, Rockford, IL. Freshwater Mussel Conservation Society Biennial Symposium, San Antonio, TX.

Sarah Douglass

Douglass, S.A., J.S. Tiemann, E.J. Kessler, and M.J. Dreslik. 2019. A preliminary analysis of mussel population dynamics in the Kishwaukee River. Illinois American Fisheries Society Annual Meeting, Champaign, IL.

Dreslik, M.J., J. A Crawford, and S. J. Baker. 2019. Assessing abundance of a cryptic viper using N- Mixture models. Biology of the Pit-Vipers 3, Rodeo, NM. Poster.

Dreslik, M.J., E. J. Kessler, K. A. Buhlmann, and P. P. VanDijk. 2019. Rapid demographic assessments for freshwater turtles: filling in data deficiencies. Spotted, Blanding's, and Wood Turtle Conservation Symposium, Berkeley Springs, WV.

Dreslik, M.J., E. J. Kessler, J. P. Ross, K. A. Buhlmann, and P. P. van Dijk. 2019. Rapid demographic assessments for freshwater turtles: filling in data deficiencies. Turtle Survival Alliance, Tucson, AZ.

Dreslik, M.J., J. A. Crawford, S. J. Baker, and C. A. Phillips. 2019. Monitoring Eastern Massasauga populations within the Carlyle Lake region. 79th Annual Midwest Midwest Fish and Wildlife Conference, Cleveland, OH.

Edmonds, D., and M. J. Dreslik. 2019. Clutch size in an Illinois Ornate Box Turtle (*Terrapene ornata*) population. Turtle Survival Alliance, Tucson, AZ.

Hohoff, T. C. 2019.Fermilab Ecological Land Management Committee December 2019. Bat surveys at Fermilab: three-year summary.

Hohoff, T,C. 2019. Chicago Wilderness Wildlife Committee February 2019. The status of Illinois bats five years after confirmation of White-nose Syndrome.

Hohoff, T.C., A.B. Cable, J.A. Kath, A.M. Holtrop, and M.A. Davis. 2019. Year three of the Illinois Bat Conservation Program. Wild Things, Rosemont, IL. Poster.

Jesper, A. C. B., and M. J. Dreslik. 2019. Timing and temperature cures of spring emergence for the Timber Rattlesnake (*Crotalus horridus*) in Illinois. Biology of the Pit-vipers 3, Rodeo, NM.

Kessler, E. J., S. M. LaGrange, and M. J. Dreslik. 2019. Ontogeny of movement behavior in Alligator Snapping Turtles (*Macrochelys temminckii*): insights from a reintroduced population. Turtle Survival Alliance, Tucson, AZ.

Phillips, C. A., S. J. Baker, and M. J. Dreslik. 2019. Combating threats to the Eastern Massasauga with directed conservation action in Illinois. 79th Annual Midwest Fish and Wildlife Conference, Cleveland, OH.

Rahlin, A. 2019. Secretive marsh bird occupancy in Illinois and Indiana. Poster presentation for American Ornithological Society conference, Anchorage, AK.

Rahlin, A. 2019. Secretive marsh birds in the big city. Co-talk with Audubon collaborator Stephanie Beilke for Wild Things Conference, Chicago, IL.

Rahlin, A. 2019. Using environmental DNA to detect rails. Lightning talk for Midwest Fish and Wildlife conference, Cleveland, OH.

Redmer, M., M. J. Dreslik, and E. T. Hileman. 2019. Tracking recovery goals for the conservation reliant Eastern Massasauga Rattlesnake. 79th Annual Midwest Midwest Fish and Wildlife Conference, Cleveland, OH.

Ross, J. P., Dreslik, M. J., and D. Thompson. 2019. Population viability analysis and the role of head-starting for a northern Illinois Blanding's Turtle population. Spotted, Blanding's, and Wood Turtle Conservation Symposium, Berkeley Springs, WV.

Ross, J. P., D. Thompson, and M. J. Dreslik. 2019. Population viability analysis and the role of head-starting for a northern Illinois Blanding's Turtle (*Emydoidea blandingii*) population. Biology of the Pit-vipers 3, Rodeo, NM.

Ross, J.P., D. Thompson, and M.J. Dreslik. 2019. Population Viability analysis and the role of head-starting for a northern Illinois Blanding's Turtle (*Emydoidea blandingii*) Population. Turtle Survival Alliance Conference, Tucson, Arizona.

Ross, J.P., D. Thompson, and M.J. Dreslik. 2019. Demographic Influence of Head-starting on a Blanding's Turtle (*Emydoidea blandingii*) Population in DuPage County, Illinois Chicago Wilderness Wildlife Committee Seminar, Chicago, Illinois.

Ross, J.P., D. Thompson, and M.J. Dreslik. 2019. Population Viability Analysis and the Role of Head-starting for a northern Illinois Blanding's Turtle (*Emydoidea blandingii*) population in Illinois. Illinois Department of Natural Resources Brownbag Seminar, Springfield, IL.

Schrage, A. C., J. L. Robinson, and M. J. Dreslik. 2019. Foraging and nesting habitat of a *Bombus* community in a documented *B. affinis* site in northern Illinois. BOMBUSS 2.0: building our methods by using sound science, next steps in North American bumble bee monitoring and conservation, Toronto, CAN.

Sherwood, J. L., A. J. Stites, J. S. Tiemann, and M. J. Dreslik. 2019. Assessing the distribution of Iowa Darters (*Etheostoma exile*) in Illinois. Chicago Wilderness Wildlife Committee Meeting, Chicago, IL.

Joshua Sherwood

Sherwood, J. L., E. E. Bilger, A. J. Stites, and M. J. Dreslik. 2019. Population demographics and diet of Bigeye Chub (*Hybobpsis amblops*) in Illinois. 79th Annual Midwest Fish and Wildlife Conference, Cleveland, OH. Poster.

2018

Adamovicz, L., C. A. Phillips, S. J. Baker, M. J. Dreslik, and M. C. Allender. 2018. Modeling individual Ornate Box Turtle (*Terrapene ornata*) health at Nachusa Grasslands. Nachusa Grasslands Science Symposium, Nachusa, IL.

Douglass, S.A., J.S. Tiemann, M.J. Dreslik, E.J. Kessler, C.A. Phillips, and S.J. Baker. 2018. INHS mussel projects in the Kishwaukee River.

Chicago Wilderness Wildlife Committee's 2018 Seminar Meeting, St. Charles, IL.

Douglass, S.A., E.J. Kessler, and M.J. Dreslik. 2018. Freshwater mussel movement in the Kishwaukee River. Illinois American Fisheries Society Annual meeting, Pere Marquette, IL. Poster.

Dreslik, M.J., E. J. Kessler, J. L. Carr, D. B. Ligon, and S. Ballard. 2018. Post-release growth rates of translocated Alligator Snapping Turtles (*Macrochelys temminckii*). Turtle Survival Alliance, Fort Worth, TX.

Dreslik, M.J., C. E. Petersen, S. M. Goetz, J. D. Kleopfer, and A. H. Savitsky. 2018. Factors affecting the movements of Timber Rattlesnakes (*Crotalus horridus*) from the mid–Atlantic coastal plain. Venomous Herpetology Symposium, Miami, FL.

Dreslik, M.J., E. J. Kessler, J. L. Carr, D. B. Ligon, and S. Ballard. 2018. Mortality is too damn high: challenges of Alligator Snapping Turtle (*Macrochelys temminckii*) translocations. Turtle Survival Alliance, Fort Worth, TX.

Edmonds, D. A. R. Kuhns, and M. J. Dreslik. 2018. Growth in a central Illinois Eastern Box Turtle (*Terrapene carolina carolina*) population. Turtle Survival Alliance, Fort Worth, TX.

Andrew Kuhns

Edmonds, D. R. Nyboer, and M. J. Dreslik. 2018. Population dynamics of the Ornate Box Turtle (*Terrapene ornata*) at two sites in Illinois. Turtle Survival Alliance, Fort Worth, TX.

Feng, C. Y., D. Mauger, J. P. Ross, and M. J. Dreslik. 2018. A demographic matrix–model analysis of Spotted Turtles (*Clemmys guttata*) in Illinois. Turtle Survival Alliance, Fort Worth, TX.

Hohoff, T. C.. 2018. Fermilab Ecological Land Management Committee November 2018. Bat surveys at Fermilab: year two.

Hohoff, T.C., A.B. Cable, M.M. Safford, T.R. West, J.A. Kath, A.M. Holtrop, J.L. Deppe, and Mark A. Davis. 2018. Year Two updates of the Illinois Bat Conservation Program. Illinois Chapter of The Wildlife Society.

Jesper, A. C. B., and M. J. Dreslik. 2018. Timing and temporal cues of spring emergence for the Timber Rattlesnake (*Crotalus horridus*) in Illinois. Venomous Herpetology Symposium, Miami, FL.

Niemiller, M. N., T. E. Carter, M. J. Dreslik, N. S. Gladstone, K. D. Kenall Niemiller, L. E. Hayter, and B. M. Fitzpatrick. 2018. Demography and life history of cave-dwelling *Gyrinophilus* salamanders in eastern Tennessee, USA. International Conference on Subterranean Biology, Aveiro, Portugal.

Perry, L. C., J. L. Carr, M. J. Dreslik, and K. Soileau. 2018. Coordinated surveys for Alligator Snapping Turtles in Louisiana. Southeastern Association of Fish and Wildlife Agencies, Mobile, AL.

Rahlin, A. 2018. Using environmental DNA to determine cryptic wetland bird occupancy. Poster presentation for American Ornithological Society Conference, Tucson, AZ.

Ross, J.P., D. Thompson, and M.J. Dreslik. 2018. Demographic Influence of head-starting on a Blanding's Turtle (*Emydoidea blandingii*) population in DuPage County, Illinois. Turtle Survival Alliance Conference, Fort Worth, TX.

Ross, J.P., C.Y. Feng, and M.J. Dreslik. 2018. Poster: A demographic matrix-model analysis of Spotted Turtles (*Clemmys guttata*) in Illinois. Turtle Survival Alliance Conference, Fort Worth, TX.

Ross, J. P., D. Thompson, and M. J. Dreslik. 2018. Demographic influence of head–starting on a Blanding's Turtle (*Emydoidea blandingii*) population in DuPage County, Illinois. Turtle Survival Alliance, Fort Worth, TX.

West, T. R., S. J. Baker, M. L. Niemillller, A. J. Stites, K. T. Ash, M. A. Davis, M. J. Dreslik, and C. A. Phillips. 2018. Evaluation of environmental DNA to detect *Sistrurus catenatus* and *Ophidiomyces ophiodiicola* in crayfish burrows. Venomous Herpetology Symposium, Miami, FL.

2017

Baker, S. J., M. J. Dreslik, C. A. Phillips, and M. C. Allender. 2017. Impact of snake fungal disease on population viability. Joint Meeting of American Society of Ichthyologists and Herpetologists, Society for the Study of Amphibians and Reptiles, and Herpetologists' League. Austin, TX.

Douglass, S.A., A.P. Stodola, and S.J. Chiavacci. 2017. Development of restoration criteria for freshwater mussel species in Greatest Conservation Need in Illinois. Freshwater Mussel Conservation Society International Symposium, Cleveland, OH.

Dreslik, M.J. 2017. Status of the Eastern Massasauga in Illinois. Eastern Massasauga Conservation and Coordination Meeting, Carlyle, IL.

Dreslik, M.J., J. A. Crawford, S. J. Baker, W. E. Peterman, and C. A. Phillips. 2017. Detection probability and capture yield of an imperiled species. Biology of Snake 2017 Conference, Rodeo, NM.

Dreslik, M.J., C. E. Petersen, S. M. Goetz, J. D. Kleopfer, and A. H. Savitzky. 2017. Spatial ecology of the Timber Rattlesnake (*Crotalus horridus*) from the mid-Atlantic coastal plain. Biology of Snake 2017 Conference, Rodeo, NM.

Dreslik, M.J., C. E. Petersen, S. M. Goetz, J. D. Kleopfer, and A. H. Savitzky. 2017 Factors affecting the movements of Timber Rattlesnakes (*Crotalus horridus*) from the mid-Atlantic coastal plain. Biology of Snake 2017 Conference, Rodeo, NM. Poster.

Dreslik, M.J., C. E. Petersen, S. M. Goetz, J. D. Kleopfer, and A. H. Savitzky. 2017. Spatial ecology of the Timber Rattlesnake (*Crotalus horridus*) from the mid-Atlantic coastal plain. Joint Meeting of American Society of Ichthyologists and Herpetologists, Society for the Study of Amphibians and Reptiles, and Herpetologists' League. Austin, TX. Poster.

Hedrick, A. R., H. M. Klondaris, L. C. Corichi, M. J. Dreslik. J. B. Iverson. 2017. The effects of climate on annual variation in reproductive output in Snapping Turtles (*Chelydra serpentina*). Turtle Survival Alliance, Charleston, SC.

Hohoff, T. C.. 2017. Fermilab Ecological Land Management Committee. Bat Surveys at Fermilab: year one.

Hohoff, T.C. and J.L. Deppe. 2017. Influence of Survey Method on Detection Probability of Common Species in Northern Illinois. Midwest Bat Working Group Conference April 2017.

Tara Hohoff

Hohoff, T.C., M.M. Safford, A.B. Cable, J.A. Kath, A.M. Holtrop, J.L. Deppe, and S.J. Taylor. 2017. Research, monitoring, and outreach in the Illinois Bat Conservation Program's first year. Midwest Bat Working Group Conference.

Lagrange, S. 2017. Southern Illinois University Herpetology Club. The Alligator Snapping Turtle (*Macrochelys temminckii*). Oral Presentation.

Seth LaGrange

Rahlin, A. 2017. Using environmental DNA sampling methods to determine cryptic wetland bird occupancy in Illinois. Ecological Society of America Conference, Portland, OR. Poster.

Ross, J.P., C.Y. Feng, and M.J. Dreslik. 2017. Evaluating turtle passage gates using remote camera traps and visual encounter surveys. Turtle Survival Alliance Conference, Charleston, SC. Poster.

Ross, J.P., C.Y. Feng, and M.J. Dreslik. 2017. Evaluating reptile and amphibian passage gates using remote camera traps. Joint Meeting of Ichthyologists and Herpetologists, Austin, TX.

Ross, J. P., C. Y. Feng, and M. J. Dreslik. 2017. Evaluating turtle passage gates using remote camera traps and visual encounter surveys. Turtle Survival Alliance, Charleston, South Carolina.

Ross, J. P., C. Y. Feng, and M. J. Dreslik. 2017. Evaluating reptile and amphibian passage gates using remote camera traps. Presentation. Joint Meeting of American Society of Ichthyologists and Herpetologists, Society for the Study of Amphibians and Reptiles, and Herpetologists' League. Austin, TX.

Sherwood, J.L., and J.A. Stein. Habitat and fish community changes of Champaign County, Illinois, over the past century. 2017 Joint Meeting of Ichthyologists and Herpetologists. Poster.

Sherwood, J.L. and J.A. Stein. "The Fishes of Champaign County": 4th edition. 2017 Annual Meeting of the Illinois Chapter of the American Fisheries Society and 2017 American Fisheries Society – North Central Division, Rivers and Streams Technical Committee Meeting.

Stites, A.J., J.L. Sherwood, J.S. Tiemann, and M.J. Dreslik. 2017. Assessing the distribution of Iowa Darters in streams of northern Illinois. 2017 Annual Meeting of the Illinois Chapter of the American Fisheries North Central Division, Rivers and Streams Technical Committee Meeting.

Andrew Stites

Sites, A. J., J. L. Sherwood, J. S. Tiemann, and M. J. Dreslik. 2017. Assessing the distribution of Iowa Darters (*Etheostoma exile*) in streams of northern Illinois. Illinois Chapter of the American Fisheries Society Annual Meeting. Moline, IL.

Sites, A. J., J. L. Sherwood, J. S. Tiemann, and M. J. Dreslik. 2017. Assessing the distribution of Iowa Darters (*Etheostoma exile*) in streams of northern Illinois. Presentation. Joint Meeting of American Society of Ichthyologists and Herpetologists, Society for the Study of Amphibians and Reptiles, and Herpetologists' League. Austin, TX.

Stites, A.J., J.L. Sherwood, J.S. Tiemann, and M.J. Dreslik. 2017. Assessing the distribution of Iowa Darters (*Etheostoma exile*) in streams of northern Illinois. North Central Division of the American Fisheries Society, Rivers and Streams Technical Committee Meeting. Milan, IL.

2016

Baker, S. J., M. J. Dreslik, C. A. Phillips, and M. C. Allender. 2016. Impact of snake fungal disease on population viability. Biology of Snakes Conference, Rodeo, NM.

Baker, S. J., M. J. Dreslik, Christopher A. Phillips, and Matthew C. Allender. 2016. Hematology and emergence of snake fungal disease in Illinois Eastern Massasaugas (*Sistrurus catenatus*). Joint Meeting of American Society of Ichthyologists and Herpetologists, Society for the Study of Amphibians and Reptiles, and Herpetologists' League. New Orleans, LA.

Baker, S. J., M. J. Dreslik, and C. A. Phillips. 2016. Long–term monitoring of the Eastern Massasauga in Illinois. 76th Midwest Fish and Wildlife Conference, Grand Rapids, MI.

Davis, Mark A., M. J. Dreslik, S. J. Baker, C. A. Phillips, C. Smith, R. Repp, and G. Schuett. 2016. A comparative assessment of pit viper life histories using robust quantification. Joint Meeting of American Society of Ichthyologists and Herpetologists, Society for the Study of Amphibians and Reptiles, and Herpetologists' League. New Orleans, LA.

Douglass, S.A., J.S. Tiemann, M.J. Dreslik, C.A. Phillips, and S.J. Baker. 2016. INHS Kishwaukee mussel projects. Illinois Consortium for Land and Aquatic Mollusks (ICLAM) Symposium, Champaign, IL.

Dreslik, M.J., J. A. Crawford, S. J. Baker, W. E. Peterman, and C. A. Phillips. 2016. Factors affecting the detection probability and capture yield of an imperiled species. Joint Meeting of American Society of Ichthyologists and Herpetologists, Society for the Study of Amphibians and Reptiles, and Herpetologists' League. New Orleans, LA.

Dreslik, M.J., J. A. Crawford, S. J. Baker, W. E. Peterman, and C. A. Phillips. 2016. Factors affecting the detection probability and capture yield of an imperiled species. 76th Midwest Fish and Wildlife Conference, Grand Rapids, MI.

Dreslik, M.J. 2016. Blanding's Turtle conservation and management in Illinois. Blanding's & Wood Turtle Conservation Symposium, Westborough, MA.

Dreslik, M.J. 2016. Controlled burning and amphibians and reptiles – a hot topic. Annual IDNR Division of Natural Heritage Retreat, Springfield, IL.

Feng, C. Y., and M. J. Dreslik. 2016. Sex differentiation in the growth of Spotted Turtles (*Clemmys guttata*). Joint Meeting of American Society of Ichthyologists and Herpetologists, Society for the Study of Amphibians and Reptiles, and Herpetologists' League. New Orleans, LA.

Feng, C. Y., and M. J. Dreslik. 2016. Sex differentiation in the growth of Spotted Turtles, *Clemmys gutatta*. 76th Midwest Fish and Wildlife Conference, Grand Rapids, MI.

Feng, C. Y., D. Mauger, J. P. Ross, and M. J. Dreslik. 2016. A long–term demographic analysis of Spotted Turtles (*Clemmys guttata*) in Illinois. Joint Meeting of American Society of Ichthyologists and Herpetologists, Society for the Study of Amphibians and Reptiles, and Herpetologists' League. New Orleans, LA.

Kessler, E. J., J. P. Ross, C. A. Phillips, and M. J. Dreslik. 2016. Brownian bridge movement models using telemetry data: a case study with Eastern Box Turtles, *Terrapene carolina*. 76th Midwest Fish and Wildlife Conference, Grand Rapids, MI.

Murray, K.L., T.C. Hohoff, T.J. Catton, B. Heeringa, and K. Kirschbaum. 2016. A Preliminary evaluation of automated bat call classifiers using acoustic transect data from Superior, Chippewa, and Chequamegon-Nicolet National Forests. Midwest Bat Working Group Conference.

Ross, J.P., and M.J. Dreslik. 2016. Spatial ecology of the Smooth Softshell Turtle (*Apalone mutica*) in the Kaskaskia River of Illinois. Joint Meeting of Ichthyologists and Herpetologists. New Orleans, LA.

Ross, J. P., and M. J. Dreslik. 2016. Population and community structure of Smooth Softshell (*Apalone mutica*) and Spiny Softshell (*Apalone spinifera*) turtles in the Kaskaskia River of Illinois. Joint Meeting of American Society of Ichthyologists and Herpetologists, Society for the Study of Amphibians and Reptiles, and Herpetologists' League. New Orleans, LA.

Jason Ross

Ross, J. P., and M. J. Dreslik. 2016. Spatial ecology of the Smooth Softshell turtle (*Apalone mutica*) in the Kaskaskia River of Illinois. Joint Meeting of American Society of Ichthyologists and Herpetologists, Society for the Study of Amphibians and Reptiles, and Herpetologists' League. New Orleans, LA.

Stites, A. J., J. Sherwood, J. S. Tiemann, and M. J. Dreslik. 2016. Reassessment of Iowa Darter habitat in Illinois. Joint Meeting of American Society of Ichthyologists and Herpetologists, Society for the Study of Amphibians and Reptiles, and Herpetologists' League. New Orleans, LA.

Stites, A. J., J. L. Sherwood, J. S. Tiemann, and M. J. Dreslik. 2016. Reassessment of Iowa Darter habitat in Illinois. 76th Midwest Fish and Wildlife Conference, Grand Rapids, MI.

Tiemann, J. S., S. J. Baker, S. A. Douglass, C. A. Phillips, and M. J. Dreslik. 2016. Assessment of a freshwater mussel community and short distance translocation in Northern Illinois. 76th Midwest Fish and Wildlife Conference, Grand Rapids, MI.

2015

Anthonysamy, W.J.B., M. Dreslik, M. Douglas, D. Thompson, G. Klut, A. Kuhns, D. Mauger, G. Glowacki, and C. Phillips. 2015. Genetic patterns among rare and common turtle species. Joint Meeting of American Society of Ichthyologists and Herpetologists and Herpetologists' League. Reno, NV.

Baker–Wylie, S. J., J. S. Tiemann, C. A. Phillips, and M. J. Dreslik. 2015. Assessment of a freshwater mussel community and short distance translocation in northern Illinois. International Urban Wildlife Conference, Lincoln Park Zoo, Chicago, IL.

Baker–Wylie, S. J., J. S. Tiemann, M. J. Dreslik, and C. A. Phillips. 2015. Assessment of a freshwater mussel community and short distance translocation in northern Illinois. 9th Biennial Freshwater Mussel Conservation Society, St. Louis, MO.

Baker–Wylie, S. J., J. S. Tiemann, M. J. Dreslik, and C. A. Phillips. 2015. Assessment of a freshwater mussel community and short distance translocation in northern Illinois. 53rd Annual Meeting of the Illinois Chapter of the American Fisheries Society, Pere Marquette, IL.

Baker–Wylie, S. J., D. B. Wylie, M. J. Dreslik, and C. A. Phillips. 2015. Prevalence of snake fungal disease in (*Sistrurus catenatus*) from Illinois. 75th Midwest Fish and Wildlife Conference, Indianapolis, IN.

Douglass, S., A. Stodola, A. Fritts, and R. Vinsel. 2015. Investigation of freshwater mussel glochidia presence on Asian carp and native fishes of the Illinois River. Society for Freshwater Science Annual meeting, Milwaukee, WI.

Douglass, S., A. Stodola, A. Fritts, and R. Vinsel. 2015. Investigation of freshwater mussel glochidia presence on Asian carp and native fishes of the Illinois River. Illinois American Fisheries Society Annual meeting, Pere Marquette, IL.

Hohoff, T.C., J.L. Deppe, K. Gaines, E. Bollinger. 2015. Use of multiple methods to verify bat species occupancy in northern Illinois. Illinois Chapter of The Wildlife Society.

Kessler, E. J., M. C. Allender, S. J. Baker–Wylie, and M. J. Dreslik. 2015. Assessing health through hematology in head-started Alligator Snapping Turtles (*Macrochelys temminckii*). Turtle Survival Alliance, Tucson, AZ.

Kessler, E. J., S. R. Ballard, C. A. Phillips, and M. J. Dreslik. 2015. Preliminary results of a translocation of head–started Alligator Snapping Turtles (*Macrochelys temminckii*) in Illinois. Turtle Survival Alliance, Tucson, AZ.

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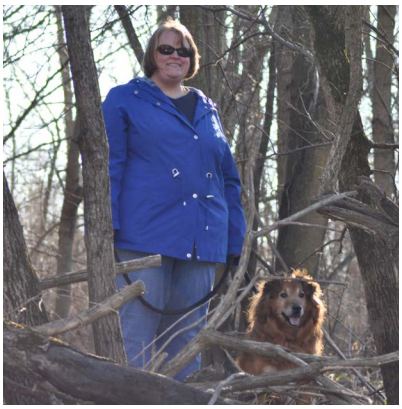

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